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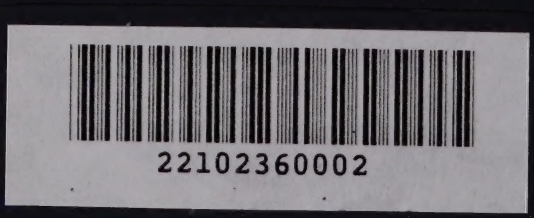
DEMOGRAPHY

OF

SOUTH AUSTRALIA

T. BORTHWICK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A CONTRIBUTION

TO THE

DEMOGRAPHY

OF

SOUTH AUSTRALIA

(Being the Thesis presented to the University of Edinburgh for the Degree of M.D., and deemed worthy of competing for the Gold Medal.)

BY

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London:

BAILLIERE, TINDALL AND COX,

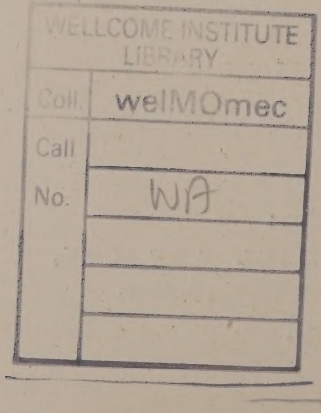
20–21, KING WILLIAM STREET, STRAND.

1891.

1991

LONDON :
HARRISON AND SONS, PRINTERS IN ORDINARY TO HER MAJESTY,
ST. MARTIN'S LANE.

12199060



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PREFACE.

THE term Demography is here used in its broadest sense, and its scope may be gathered from the following statement of the plan of this thesis. It embraces a description of the geographical features of the colony which have a hygienic relationship; of the meteorological conditions and their relation to certain diseases; of the sanitary progress of the colony—referring to special difficulties, special works, and special legislation; also a tabulation of all the available vital statistics, and a reference to certain diseases which seem to demand separate notice. The object of the thesis is to present these facts in such a manner as to form a basis of comparison between a new country and older communities, and to assist in throwing light on some of the various problems which relate to the public health.

Keeping this object in view, an endeavour has been made to avoid constructing theories as far as possible on insufficient data, and to present a series of facts alone which, it is hoped, may be of use to other workers in sanitary science, and may form a basis for more detailed investigation, especially in the Australian colonies. Such is the apology for the appearance of this paper in book-form.

Referring to the statistics, they are brought up to December 31st, 1889, as figures were only available up to that date at time of writing. It may be found that some of the tables are not completely in accordance with those given in official reports; this is owing partly to a want of correspondence in the data from which the tables are compiled (as will be pointed out when it occurs), and

partly to a want of correspondence in the various official reports themselves, which is sometimes perplexing. However, in order to eliminate error as far as possible, the original returns in the hands of the Registrar-General have been in all cases dealt with, and consequently the tables presented in this work may be taken as practically correct.

In conclusion, it is only fitting that acknowledgment should be made of the facilities for investigation afforded by the Under Secretary, the Government Astronomer, the President of the Central Board of Health, and the Registrar-General of Births, Deaths, and Marriages.

Adelaide, S.A.

A CONTRIBUTION

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South Australia comprises a section of the Australian continent extending from north to south. On its west is the colony of Western Australia, and on its east lie the colonies of Queensland, New South Wales, and Victoria. Its northern limit is exceeded only by a few miles by the most northerly point of Queensland, while a large part of Victoria lies further south. It thus appears that the name, South Australia, is misleading. It has been proposed to change it to Central Australia; but this term can scarcely be applied correctly to a country which extends from north to south of the continent. Perhaps the proper designation would be Middle Australia, or to use one word, Mes-Australia. The northern half of this middle section of the continent is known as the Northern Territory, and its annexation dates from 1863. Lying north of the 26th parallel of latitude, it is consequently largely within the tropics, and will not be included in this inquiry.

South Australia proper is bounded on the east by the 141st, and on the west by the 129th degree of east longitude. The 26th parallel of south latitude forms the northern boundary, as just mentioned, and it is bounded on the south by the Southern Ocean —the coast line extending from the 38th to the 31st 45′ parallel of south latitude—a distance of over 2,000 miles. It comprises an area of 380,070 square miles.

Physical Features.—The southern coast line is broken *by two large bays*, known as St. Vincent's and Spencer's Gulfs, the former extending 90, the latter 200, miles inland. The one overlaps the other to some extent; and between the two lies a tongue of land called Yorke's Peninsula. The only other bays which affect the

configuration of the country to any extent are Encounter Bay and the Great Australian Bight. It is thus apparent that a large part of the colony is exposed to the influence of the sea.

Parallel to the two principal gulfs lies *a range of mountains* known generally as the Mount Lofty Range, from the name of its highest point, which attains an elevation of 2,334 feet above sea level. It begins at Cape Jervis in the south, and with an average breadth of 30 miles, extends in a northerly direction to the head of St. Vincent's Gulf, where it separates into several ranges running parallel to each other. Further on, it is called variously the Hummocks and the Flinders Range, the highest point of the latter being over 3,000 feet. Beyond the gulf, the range trends in an easterly direction, and ends in a series of hills about 29° 31′ south latitude. To the west of the head of Spencer's Gulf is the Gawler Range, while detached ranges are found further south in Eyre's Peninsula. In addition to these distinct ranges, there exist in the south-east several isolated peaks, which are evidently extinct volcanoes—the principal being Mount Gambier and Mount Schanck. Low ridges of hills occur in various other parts of the colony.

The Mount Lofty Range divides *the river system* of the colony. On the eastern side are several small rivers—the Gawler, Torrens, Onkaparinga, &c., which empty themselves into the gulf. These have their origin in the range, and vary considerably in length and volume, some being full in winter and practically dried up in summer. On the western side of the range are also some small rivers, the Hindmarsh and Inman flowing into Encounter Bay, and others finding their way into the Murray; but the only river of importance in the colony is the one just mentioned—namely, the Murray. This river takes its rise in New South Wales, and has a course of 500 miles through South Australia, first in a westerly and then in a southerly direction, finding its outlet through a series of lakes into Encounter Bay; it is navigable for the whole of that distance. In the interior of the colony are to be found watercourses of great length, but they are often dry for long periods. The floodwaters of south-west Queensland are carried by some of these courses, and during certain exceptionally wet seasons the country is inundated for hundreds of miles. These waters find their way into the lakes, or lose themselves in the sandy plains.

The Lakes of the colony are few and of little importance. In the interior are those just referred to—Lakes Gairdner, Torrens, Eyre, &c.; they are fed by the floodwaters of the surrounding

country, but are frequently almost dry and represented by basins of mud and salt. The lakes at the mouth of the Murray have also been mentioned, and are known as Alexandrina, Albert, and the Goorong; the last extends for about a hundred miles parallel to the coast. In the south-east are several volcanic lakes, the principal being the Blue Lake, which lies in the crater of Mount Gambier.

The Geological formation of the colony may be shortly described as follows: "The rocks of the mountain ranges belong to the oldest of the sedimentary series, and outcrops of the same formation are to be seen in many places rising like islands above the surrounding and newer strata. Much of the interior must be classed as secondary, including the great stony downs and table-lands, where sandstone conglomerate, quartzite, gypseous clays, and limestone, in some places highly fossiliferous, are met with. North of Lake Torrens, extending from the Nullabor Plains to the eastern boundary of the colony, is a broad expanse of tertiary and post-tertiary deposits, interrupted by plutonic rocks at the Gawler Ranges and the primaries that have been referred to. In some places the tertiaries are 300 feet in thickness, and seem to indicate a period of slow submergence when beds of sandstone and limestone, rich in marine fossils, were formed. Plutonic rocks occur in several localities, and on the extreme south-east is a series of extinct volcanoes. There appears to be an utter absence of carboniferous and carbonaceous rocks."

The general nature of the country may to some extent be inferred from the preceding description. The mountain ranges are, on the whole, well-wooded with various kinds of Eucalypti, and have well-grassed valleys and plains interspersed among them. Fertile plains lie between the gulf and the ranges, while to the eastward vast plains of mallee scrub and salt-bush extend into the adjoining colonies. North of Spencer's Gulf there is an extensive shallow depression containing the lakes and vast plains of stony desert. Towards Western Australia, so far as it has been explored, the country seems to consist of dense scrub and sand hills; but towards the Queensland border and in various other parts of the interior there is some good pastoral country.

Among the interesting features of central Australia may be mentioned the "mound springs"—conical hillocks occurring singly or in groups from which water flows. They are natural artesian wells, some of them being warm and others impregnated with salts, the deposit of which assists to form the mounds. The natives are said to use these springs for medicinal purposes; and it is more than

probable that a careful investigation into their properties may yield valuable results.

Meteorological Conditions.—The year may be divided into two seasons for present purposes: summer extending from October to March (inclusive), and winter from April to September (inclusive). The summer months may be described as hot and dry; the winter months cold and wet. *The temperature* is highest in January and February, when the mean at Adelaide exceeds 73°. They are closely approached by December and March with a mean of over 70°. During these months the temperature frequently exceeds 100°, and it has been recorded as high as 116°·3; but these temperatures are never of long duration. November has a mean of 66°, and October of 64° (which is slightly lower than that of April); the temperature of October has only once reached 100°, and the hot days are very few.

The heat in summer is by no means oppressive, except when it is of longer duration than usual, so as to penetrate throughout the houses, or when a hot wind, sometimes laden with dust, blows from the interior; for there are frequent intervals of cool, cloudy weather, and the excessive heat itself is rendered bearable by the extreme dryness of the air, as shown by the wet bulb registering 67°, or as much as 21° below the dry bulb. Of the winter months, the temperature is lowest in June, July, and August—the mean being under 54°. The lowest recorded temperature at Adelaide was 32°·3. The mean of May and September is about 57°. It is over 60° in April and the early part of May, and with the retained heat in the soil the rains, which begin to fall now, bring up the vegetation very quickly. This growth, immediately after summer, shows that the seasons do not correspond with those of the northern hemisphere; for the autumn is in reality spring, which is only interrupted by winter, and starts afresh towards the end of August or the beginning of September.

The Rainfall is greatest in May, June, July, and August, averaging from 2½ to 3 inches; there has been recorded a maximum of 7·8 inches in June. The average number of wet days is 13 in May, 14 in June, 16 in July, and 16 in August. April, September, and October have an average rainfall of between 1½ and 2 inches; November, of just over 1 inch, and December, January, February, and March under 1 inch. During the four last-mentioned months there is frequently little or no rain. The average annual rainfall for 51 years (1839–89) is 21·114 inches; it has been as high as 30·8

and as low as 13·4 inches. As in the case of temperature, these figures for rainfall refer to Adelaide; but there is considerable variation throughout the colony. Thus, the average annual rainfall is probably about 21 inches for 100 miles north of Adelaide; on the Mount Lofty ranges it is as much as 40; on the eastern side of the ranges and along the Murray, it varies from 18 to 12 at different places; in the south-east it is in like manner from 30 to 22; on Yorke's Peninsula 13; at the head of Spencer's Gulf about 9. The interior of the colony is frequently exposed to prolonged droughts, but occasionally heavy rains occur. These rains, when they occur in summer, are the tropical rains of the northern part of the continent which have been carried beyond their usual limits by the north-west monsoon. On the other hand, winter rains may extend well into the interior when the centre of the cyclonic disturbance passes to the north of Adelaide. As a rule, however, the centre lies to the south of the continent, the path of the disturbance being nearly parallel to the coast line from west to east, so that the rain is very uncertain north of Spencer's Gulf, and can only be relied on near the Flinders Range.

The changes in *the Barometric Pressure* proceed from west to east across the continent, and are noted in Western Australia from two to four days before reaching Adelaide. The mean of the winter months is about 30·127 inches, and of the summer months 29·990. There has been a reading recorded as high as 30·533, and as low as 29 096. The fluctuations are greatest in the winter months; the greatest range in any one month is 1·379, and the least 0·474.

During the summer *the Winds* tend towards the heated interior of the continent, and south winds predominate; while during the winter north and north-east winds prevail. Throughout the whole year the prevailing winds of the interior are south-east; but in the summer they are influenced by the north-west monsoon, which, when strong enough, sweeps south through South Australia proper as the hot wind previously referred to. Usually, the rains of the monsoon disappear about the McDonnell ranges of the northern territory, so that the hot wind is also dry; but occasionally, as already mentioned, the rains extend further south, and the climate may be almost tropical for a short time in the southern portion of the colony. It is very seldom, however, that the monsoon is strong enough to influence this portion of the colony, so that the polar currents from the south-east prevail in summer, and thus moderate the heat to a considerable extent.

The amount *of Evaporation* from the surface is greatest in January, when it varies from 9 to 11 inches, and least in June, when it varies from $1\frac{1}{2}$ to 2 inches. During the three hottest months it averages $\frac{1}{3}$ inch per day; and when a hot wind is blowing it may be as much as $\frac{6}{10}$; while in the coldest months it averages about $\frac{7}{100}$ per day.

In regard to the *state of the sky*, the summer months have from 15 to 20 almost wholly clear days; the winter months from 10 to 11. Taking the whole sky as 10, the mean amount of cloud in each month is as follows:—January, 4; February, 3; March, 4; April, 4; May, 6; June, 6; July, 6; August, 6; September, 5; October, $4\frac{1}{2}$; November, 5; December, 4.

The Climate of the colony as a whole is salubrious. The cold of winter is not excessive, and the heat of summer is compensated by the dryness of the air, which permits both work and play to be undertaken with impunity. Almost every variety of climate may be obtained. The cold wet winter of the Adelaide plains can be exchanged for the dry parts of the north; while the summer heat of the plains can be escaped at the seaside, or on the hills, where the difference in temperature is sometimes as much as 20° in the day-time. But throughout the colony, the clearness of the atmosphere and the unclouded sky render a large portion of the year exceedingly pleasant.

General Progress of the Colony.

The first settlers arrived towards the end of 1836, and during the ensuing year the only signs of civilisation were a few tents and wooden houses, some felled trees in the surrounding bush, and an occasional ship off the coast.

After an interval of half a century (December 31st, 1889) we find a population of 319,166 that has pushed its way for hundreds of miles into the interior. Over 9,000,000 acres of country have been alienated, and nearly 3,000,000 brought under cultivation. There are 170,000 horses, 324,000 cattle, and 6,400,000 sheep in the colony. The staple produce exported during the previous twelve months amounted to nearly £3,000,000; while the total export and import trade exceeded £14,000,000.

There are about 4,000 miles of main roads (as distinct from district roads); and 1,756 miles of railway have been constructed, extending nearly to the centre of the continent on the one hand, and

communicating with Melbourne on the other, while an important branch extends into New South Wales. The telegraph and telephone wires have a length of 11,677 miles; and perhaps there is no better example of the energy of this handful of people than their accomplishment of the great undertaking of carrying the telegraph right across the continent—a distance of over 2,000 miles—when it was a veritable "terra incognita." This trans-continental wire meets the cable of the Eastern Extension Telegraph Company at Port Darwin, and thus places the Australian colonies in direct communication with England.

Adelaide, the capital of the colony, has a population of 45,000. It is situated on the plains about midway between Mount Lofty and St. Vincent's Gulf on some rising ground which is exceedingly advantageous for drainage purposes. The site was selected by Colonel Light after a careful examination of the surrounding country, and it is generally admitted that a more admirable site could not have been obtained. The city is about a mile square, and the streets, which are wide and well made, run east and west, north and south. It is surrounded by a belt of land about half a mile wide, called the Park Lands, which are planted with trees and reserved for public purposes. Within the city itself are several large public squares laid out with flowers and shrubs, while the Botanic Gardens are well known on account of their ornamental and experimental value. Separating South from North Adelaide is the Torrens river, which formerly in summer consisted of a chain of offensive water-holes, but has now been converted by the construction of a dam into a fine lake which is much used for boating. Adelaide is supplied with water by Government waterworks, and has lately adopted a system of deep drainage.

The suburban towns combined exceed Adelaide in population, the individual towns varying from 1,000 up to 11,000. They are of more recent date, and consequently are not so advanced in public facilities as Adelaide.

The other corporate towns are scattered throughout the colony, and may be classed as seaport towns, mining towns, and agricultural towns. Port Adelaide and Port Augusta may be taken as examples of the first class, Kadina and Kapunda of the second, and Jamestown and Clare of the third. Further reference to these towns will, however, be deferred, as it is their sanitary condition which principally concerns us.

Sanitary Progress.—In a new country it is evident that a large

amount of energy is necessarily expended in bringing nature under subjection. The necessity of living is so real, that the manner of living is for the time of secondary importance; in fact, there is so much for the strongest to do that the weak are permitted to go to the wall. Accordingly, it is not to be wondered at that sanitary requirements were sadly neglected in the early days of the colony, and that progress has been slow. Previous to 1873 there was no special legislation in the direction of conserving the public health. In the various municipal Acts which were passed before that date, the corporations had power "to adopt all such measures as they may deem necessary for the cleansing of the said city and the preservation of the public health, and for the prevention and suppression of nuisances." This seems comprehensive enough, but the energy of the corporations was mostly spent in other directions so that the sanitary result was feeble enough. As far as the colony outside the corporate towns was concerned, there was no provision whatever made except that the Governor in Council might make an order in case of emergency. In 1873 "The Public Health Act" was passed, it was amended in 1876, and again in 1884. On the whole the result of this Act has been beneficial, as will be shown afterwards; but it must be admitted that the sanitary condition of the colony generally is still unsatisfactory. A few examples will suffice to show this, and official reports will be quoted. Taking Adelaide first, it may be mentioned that an ample water supply was introduced about 1857, but it was not until 1882 that the deep drainage works were commenced. Dr. Whittell, the President of the Central Board of Health, described the state of the city: "A city of stinks from one end to the other." It appears that the drainage was effected to a large extent by open channels in the streets, while the cesspits were badly constructed and leaky so that the ground became sodden with filth. So late as 1883 he reported thus: "I have no alternative but to report that there exists in nearly all parts, and sometimes in the midst of people of most cleanly habits, houses and premises which are in such an insanitary condition as to be dangerous in a high degree to the whole population, and that having this fact in view there is no reason for surprise that, as shown by the evidence of the Officer of Health for Adelaide, the death-rate per 1,000 is far in excess of that in other parts of South Australia." In regard to the other corporate towns, some of those already mentioned may be taken as examples; and the following extracts are from reports of the Chief Inspector of the Central Board:—"*Kapunda.*—Cesspits,

as a rule, are not constructed in accordance with the provisions of the Public Health Act. Piggeries are not well constructed, and some of them are offensive. In parts of the town offensive accumulations of house refuse and other matters are met with." "*Kadina.*—As is always the case where no systematic plan of scavenging is adopted, large quantities of house refuse, manure, and other filth are found lying about the premises of private residences. Generally, the cesspools are merely holes in the ground." "*Clare.*—The scavenger is supposed to visit houses once a fortnight and to remove all refuse; but, judging from the accumulations met with, the work appears to be done in a very imperfect manner. Privy cesspits are merely holes in the ground, nearly filled with soakage water, and offensive. There are numerous shallow wells in use, and it is scarcely possible that these wells escape contamination by soakage." Such instances might be multiplied indefinitely, but it will suffice to mention the *District of Paynham* as illustrating the country outside corporate towns—"Found a number of common nuisances existing, such as unpaved cowyards, dilapidated and offensive privies, dirty unpaved pigsties, &c." These extracts are from recent reports, and it is apparent that throughout the colony hygienic conditions are bad—defective drainage, imperfect construction of cesspits, tainted water supply, and insufficient scavenging arrangements being perhaps the chief faults. Their evil effects are doubtless to some extent counteracted by the healthy climatic conditions and the comparative sparseness of the population, not only in the country districts, but also in the towns.

Some special Sanitary difficulties that occur in a new country may be referred to. It has already been pointed out that sanitary work generally must, through force of circumstances, take a secondary position. This neglect which is perhaps excusable, along with culpable neglect, is the occasion of many widespread outbreaks of infectious disease. Perhaps this is best illustrated in the case of a mineral discovery. As soon as such a discovery takes place there is a sudden rush of population to the spot. The miners take no precautions whatever in the manner of living, and the Government are always dilatory in making the necessary sanitary provisions; so that the result soon is that the camp and surrounding country become a hotbed of filth and fever. Excreta are deposited anywhere and everywhere, and are washed by rains into the wells and tanks which supply drinking water; hence, as soon as infection is introduced, there is no limit to its spread. Moreover, it spreads not only in the camp itself, but (there being no provision whatever for

treatment) the patients are taken to their homes in all parts of the colony, where fresh centres of infection are formed in places only too well prepared to receive it. In this manner various outbreaks of enteric fever have been accounted for; and for the last few years this disease has been more prevalent than it would have been under normal circumstances, owing to the sources of the above description —the Teetulpa Goldfield and the Barrier Ranges Silverfield. The latter is in New South Wales, but the population is most intimately related to South Australia, both socially and commercially; so that the patients were all sent to this colony for treatment. It is interesting to note that in this instance, where the mining discovery has been of a permanent character and sanitation has consequently received some attention, the cases of enteric fever have become comparatively rare. It is evident that such discoveries may cause sudden dislocations of population which it is difficult to foresee or to provide for; thus, a new town of many thousand inhabitants may spring up in a few months in the midst of a desert, and this takes place at the expense of other towns and villages, which may be almost deserted.

Perhaps the only other special sanitary difficulty in this colony, besides those just mentioned, is that of obtaining a pure water supply in many parts of the colony. In the first place, water is scarce; and in the next place, where it does exist it is liable to pollution. We have already seen that drainage facilities are defective throughout the colony; but this difficulty is more of a general than a special nature.

Still, these two points lead up to the consideration of *some special sanitary works* that have been undertaken to remedy them. In *regard to water supply*, the Government has carried out various works; so that many towns have been supplied with water obtained by pumping from springs, or from creeks, and conducted into tanks or reservoirs. Unfortunately, these are not always sufficiently protected from pollution. It may be mentioned that all the public works in regard to water supply and drainage are constructed by and maintained under the control of the Government. The largest work is that which supplies Adelaide and the surrounding districts with water; and accordingly it merits a special description. "The source of supply is the River Torrens, where it issues from the Mount Lofty Ranges; and the catchment area equals about 150 square miles, consisting of very hilly ranges of a slate and sandstone formation covered with poor soil and sparsely timbered. The flow

of the river is constant, but variable according to the season of the year. The headworks consist of a heavy masonry weir, constructed in a narrow gorge of the river. No filtering appliances are used, as the water, after the first winter floods have passed over the weir, becomes clear and fit for use. The intake is regulated by a sluice valve, which can be opened and closed in two minutes; and no bye-washes are used. An open aqueduct, about $3\frac{3}{4}$ miles long, conducts the water to two reservoirs, whence it is distributed to the city. The reservoirs contain respectively 140,500,000 and 886,915,752 gallons; and the consumption per diem fluctuates from 1,750,000 gallons in winter to 6,000,000 gallons in summer. The service is high pressure with constant supply, and for domestic use unstinted." When the large extent of catchment area is considered, as well as the sanitary conditions which we have seen to prevail wherever there is population, it is apparent that there must be considerable risk of pollution. Recently, attention was directed to this matter and the necessity of protecting the watershed; and an inspection ordered by the Central Board of Health revealed the existence of very many nuisances. These were removed; but unfortunately the control of the watershed is under the jurisdiction of several departments, and consequently there is the usual result of divided responsibility.

The plan adopted, which is supposed to lessen the risk of pollution and to do away with the need of filtration, is to allow the first winter floods to pass over the weir, and then, after the watershed is thoroughly scoured, to allow it to pass into the reservoirs. Hitherto, no bad effects have occurred through pollution of the water supply, and this immunity may be owing to the water being so freely exposed to the action of the air both above and below the weir.

The following analysis of the water is by Professor Rennie, of the Adelaide University:—

Total solids...	45·00	per 100,000 parts.
Chlorine	13·25	„
Free Ammonia	·004	„
Albuminoid Ammonia	·030	„
Nitrates and Nitrites	Nil.	
Oxygen consumed (Tidy's process)	·180	„

He points out that the albuminoid ammonia is very high, and that the oxygen consumed is greater than it ought to be; but that, from the comparatively small quantity of free ammonia and the

absence of nitrates and nitrites, the impurity is more of vegetable than of animal origin.

The drainage system of Adelaide was not undertaken for many years after the introduction of the water supply. The work was begun in 1882 and practically finished, as far as the city is concerned; and since then it is being extended to the suburbs. "The main sewers and branch house-drains from the sewer to the building line of the street are laid by the Government; while the house-drains inside that line are laid at the owners' cost, under the immediate supervision of the Hydraulic Department. The arrangement of all house-drains, traps, vents, and sinks is also designed by the department after conferring with the owner, so that there is uniformity of design throughout the whole system. Originally street grids were placed every 50 feet along the street sewers, but these were found to be vents for the escape of sewer gas and such intolerable nuisances that most of them were closed, and ventilating pipes fixed wherever practicable. A 'boundary or disconnecting trap' was placed at the boundary of the premises; and attention has been paid to sufficiency of traps in the house connections, as well as ventilating pipes, so that every closet, sink, bath, or cesspit is trapped and ventilated." The sewers are made up of the following lengths and sizes:—

Open concrete channel ...	...	...	...	·32	miles.
Covered „ „ ...	...	...	..	1·31	„
Egg-shaped sewers, 3 ft. 4 in. by 5 ft.			...	1·62	„
„ „ 2 ft. 8 in. by 4 ft.			...	·67	„
„ „ 2 ft. 4 in. by 3 ft. 6 in.			...	·93	„
Wrought-iron tube, 42 in. diameter ...			...	·04	„
Pipe sewers, earthenware, 24 in. diameter			...	·27	„
„ cast iron, 24 „			...	·27	„
„ earthenware, 21 „			...	·38	„
„ cast iron, 21 „			...	·19	„
„ earthenware, 18 „			...	1·11	„
„ „ 15 „			...	2·76	„
„ „ 12 „			...	7·57	„
„ „ 9 „			...	16·55	„
„ „ 6 „			...	35·71	„
Total ...			...	70·00	miles.

"The open concrete channel conveys the sewage to the *Sewage Farm*, which is situated about four miles north of the city. Adelaide being 154 feet and the farm 40 feet above sea level, the force of gravitation is sufficient to cause a rapid flow of the sewage. The farm comprised 470 acres, and the soil varies from a stiff clay to a sandy loam. It is divided into 21 paddocks, varying in size from 8 to 25 acres, and water has been laid on to each for the use of cattle depasturing on them. The farm is worked on the broad irrigation principle, combined in the winter months with intermittent downward filtration. The filter beds are thoroughly underdrained, and most effectually, the effluent carried off therefrom being perfectly clear. The sewage is first strained by revolving strainers, and is then conducted over the farm by means of cement carriers and tarred wooden troughing. The production of the land treated with sewage has been extraordinary, the crops grown consisting of lucerne, Italian rye grass, mangolds, sorghum, wheat (for hay), barley, vines, and wattles. A large number of cattle, horses, sheep, and pigs are depastured on the farm; but dairy farming had to be abandoned, on account of popular prejudice against the produce. For the last two years (ending June 30, 1889) there has been a profit over the working expenses—not including interest on working capital or rent for land." The above statements in regard to the waterworks and sewer system are to a large extent obtained from official sources. It will be of interest to *consider the special difficulties* that have occurred in the working of these systems. In regard to the waterworks there is nothing of special note. Referring to the sewer system, the chief difficulty has been already referred to—namely, the nuisance arising from the street grids. The smell proceeding from these grids in some places, particularly in North Adelaide, was so offensive that people passing along the streets felt sick, and sometimes vomited. Dr. Whittell describes the smell as sickening and most offensive—"not like that of any fæcal matter so much as it was of decomposing cabbage-water and rotten onions, different from anything I have found in connection with cesspools." This smell was not noticed in the course of the house drains, and it was inferred that the boundary traps were working effectively. It was further surmised that the smell was, in part at least, the result of the accumulation of gas between the boundary trap and the sewer, where there was no provision for ventilation, and that the grids, which were intended to allow a current of air to pass through the sewers, were ventilating the wrong way. Accordingly, the Hydraulic

Engineer carried the boundary traps back from the boundary of the premises close to the houses, where he was able to put up ventilating pipes on the sewer side of the traps. In addition, the majority of the street grids were closed, leaving only one or two open in each street; and special ventilating shafts for the sewers were put up at suitable places. The result has been the complete disappearance of the nuisance; and, according to the testimony of the Hydraulic Engineer, there is a steady current of air through the sewers, and the air in them is very much improved. It thus appears that this difficulty arose from deficient ventilation, intensified, perhaps, by climatic conditions. In regard to the Sewage Farm. I have already mentioned the popular prejudice which was the cause of the discontinuance of the dairy farm. It was considered by some that the produce might be the means of conveying enteric fever; and although no cases were traced to this source, the authorities deemed it wise to remove all cause of anxiety on the part of the public. Still, the green produce of the farm is sold to dairymen for feed, and no bad results have been noticed. In 1884 an outbreak of enteric fever occurred in the neighbourhood of the farm, and it was stated to be due to the effluvium arising therefrom. The President of the Central Board of Health investigated the matter, and reported that the cases of fever had nothing to do with the farm, except perhaps in one instance. This was the case of a man employed on the farm, who was in the habit of drinking the effluent water rather than take the trouble to go to the taps. Whether this was the origin of the fever or not it was impossible to determine; but it raises the question of the destination of disease germs in sewage farms, towards the elucidation of which there is ample room for investigation.

The following is the result of *the analysis of two samples of effluent water* from the sewage farm by Professor Rennie, the first sample having been taken after heavy rains on the two previous days, the second after scarcely any rain for a few days previously—stated in parts per 100,000 :—

Total Solids.	Free Ammonia.	Albuminoid Ammonia.	Nitrogen as Nitrates and Nitrites.	Oxygen Consumed.
(1) 177·64	0·8	0·14	0·36	0·25
(2) 247·8	0·41	0·05	1·18	0·18

He points out that as sewage usually contains from about 4·5 to 5·5 parts of free ammonia per 100,000, and either no nitrogen as nitrates and nitrites or mere traces, the above results serve to show that though the water is very impure, a considerable purification has been effected. The presence of large quantities of nitrogen as nitrates and nitrites show that a great part of the nitrogenous matter has been oxidised, and to that extent destroyed.

In the second sample, when the water was flowing at a slower rate, the presence of less ammonia but more nitrogen as nitrates and nitrites (as compared with the first sample) indicates a more effective oxidation, and this is borne out by the smaller amount of oxygen consumed.

These works—the Adelaide waterworks and the sewer system—were constructed under special Acts of Parliament.

Special Sanitary Legislation.

The Public Health Acts of 1873 and 1876 may be taken as one. They created a Central Board and Local Boards of Health. The Central Board of Health consists of a President (who has hitherto been a medical man) and four other members appointed by the Government. It has the power—limited and ill-defined unfortunately—to make regulations for the conservation of the public health and for the prevention of the spread and mitigation of infectious diseases. It also supervises and advises the Local Boards; and it can compel the latter in cases of neglect to do what it considers necessary. The Local Boards of Health are constituted by the Municipal Councils of all corporate towns; and from time to time others were formed apart from these in such places as were considered to require them. A recent "District Councils Act" has, however, constituted every District Council a Local Board of Health, so that practically the whole colony is under the jurisdiction of Local Boards. They have power to make orders and regulations for the removal and prevention of nuisances within their respective districts.

The Central Board has power to order the Local Boards to appoint Medical Officers of Health; and this power has been exercised in the case of the larger corporate towns and principal districts. This officer, however, is so poorly paid that he cannot be expected to devote much time or zeal to his duties; and, as a matter of fact he is rather encouraged not to do so than otherwise. The constit

tion of the Local Boards is against any satisfactory work being done, for the members are chosen not on account of their fitness but rather on account of their readiness to oppose any expenditure on sanitary works. On the other hand, the Central Board is hampered by a want of practical sympathy on the part of the Government. The fault of all these Public Health Acts is that they are of too tentative and permissive a character.

"*The Public Health Acts Amendment Act*" of 1884 gives power to the Government to proclaim any contagious or infectious disease, thereby rendering it compulsory on the medical attendant to notify every case of such disease to the Central Board of Health (a fee of five shillings being allowed for each case so reported). As yet, the only diseases which have been proclaimed are small-pox, cholera, and yellow fever; and as these are practically unknown in the colony, the Act is to all intents and purposes a dead letter. Of late a feeling in favour of compulsory notification has been growing; and the Local Boards of Health under which I hold the appointment of Medical Officer have at my instance taken advantage of a clause in the "Municipal Corporations Act," and adopted a system of notification of the principal infectious diseases. This system is not so perfect as could be desired, as the clause referred to permits of the onus being placed on the householder only; but it has been in operation for a few years, and worked remarkably well owing to its having the sympathy of the people. Probably, the Act of 1884 will be soon extended to the principal infectious diseases; and when this is done, along with proper attention to sanitation, the results obtained should be brilliant in a new country like this.

"*The Vaccination Act*" provides that every child born in the colony must be vaccinated within six months of birth. It is fairly well carried out, considering the scattered condition of the population, and the remoteness of some of it from medical aid.

"*The Lodging-house Act*" and its "*Amendment Act*" provide for the registration and licensing of common lodging-houses, whereby their sanitary condition may be maintained, and measures adopted for the prevention of the spread of infectious diseases.

"*The Manufacturing Districts Act*" and its "*Amendment Act*" provide for the setting apart of certain districts for manufacturing purposes under certain conditions.

"*The Sale of Food and Drugs Act*" deals with the adulteration of food and drugs.

"*The Quarantine Act*" provides for the placing in quarantine of

vessels arriving from ports which have been proclaimed as infected with small-pox, cholera, or other infectious or contagious diseases. Inspection of the crew and passengers is then made by the Health Officer, and if he finds everything satisfactory a clean bill of health is given; if, on the other hand, he finds evidence of infectious disease, he orders the vessel into quarantine, and communicates with the President of the Central Board, who advises as to further proceedings. An island near the mouth of the Port River, and in close proximity to the anchorage, has been declared a quarantine station; and passengers for this colony are removed from infected vessels (which may be going further) to this station, and cared for until all danger is over. The operation of this Act will be referred to again.

Some other Acts have an indirect bearing on public health, but need not be referred to specially.

Population.

Seeing that population forms the basis of vital statistics, it is important to study it in all its important phases, and more especially so in a new country. Thus, it is necessary to investigate the condition of the population not only in regard to numbers, but also in regard to sex and age-distribution. The occupations, as well as the educational and general conditions, of the people must also be considered, and it will be interesting to examine the nationalities of which the population is made up.

On December 31st, 1889, *the population of the Colony was estimated to be* 319,166. The last census was taken in 1881, and Table I. shows the population at the various census periods :—

Table I.

Date of Enumeration.	Population.			Increase on Previous Census.	
	Males.	Females.	Total.	Numerical.	Per Cent.
1844—February 26 ..	9,526	7,840	17,366	...	...
1846— ,, ..	12,670	9,720	22,390	5,024	28·8
1851—January 1 ...	35,302	28,398	63,700	41,310	184·5
1855—March 31 ...	43,720	42,101	85 821	22,121	34·7
1861—April 8 ..	65,048	61,782	126,830	41.009	47·7
1866—March 26 ..	85.334	78,118	163,452	36,622	28·8
1871—April 2 ..	95,408	90,218	185,626	22,174	13·5
1876—March 26 ...	110,491	102,780	213,271	27,645	14·0
1881—April 3 ...	149,530	130,335	279 865	66,594	31·2

It may be pointed out, in the first place, that the quinquennial census was discontinued after 1881 on the score of expense, as the colony had been passing through a series of bad seasons. This is unfortunate, because in a new country the population is affected to such an extent by immigration, emigration, and internal migration that its actual position is difficult to determine. A glance at the preceding table shows that, while there has always been an increase, it has varied considerably in the different intercensal periods. Up to a few years ago, the total population could be estimated with a fair

degree of accuracy, because the overland traffic to and from the Colony was so insignificant that it could be disregarded; and as the arrivals and departures by sea were supplied by the Customs authorities, it was only natural to add the excess to the natural increase in order to obtain the total increase of population. Since, however, the Colony has been in railway communication with the other colonies—with Broken Hill, a large mining centre in New South Wales, on the one hand, and with Melbourne, the capital of Victoria, on the other—it has become a less simple matter to estimate the population, especially as the Railway Commissioners regard it as "impracticable" to furnish returns of the passenger traffic; and, consequently, the estimate can only be approximately correct. Then, in regard to internal migration, it is even more difficult to estimate the condition of the population, for there is no machinery whatever to aid in the matter; and it has been already pointed out how sudden dislocations of the population may be caused by a mining discovery. In fact, the rapid changes which occur in a new country render it absolutely impossible to determine accurately the local distribution of the population. On these grounds, I contend that a quinquennial census ought to be a fixed institution in a new country.

The Influence of Immigration and Emigration is seen to be important in the preceding table, and more particularly in Table II:—

TABLE II.

Years.	Excess of		Proportion of Natural Increase to 100 of Migration Increase.
	Immigration over Emigration.	Births over Deaths.	
1836–65	52,290	52,893	101
1866–89	76,121	133,715	175
1836–89	128,412	186,608	145

It thus appears that while the proportion of natural increase to migration increase is as 145 to 100 for the whole period (1836–89,) the proportion was nearly equal for the first half of that period, while for the latter half it was 175 to 100. Accordingly, it follows that

the influence of immigration was greater in the early part of the colony's history than the later; and the effect on the age and sex distribution of the population will be referred to again. The following table shows the position of England and Wales in the preceding respects at decennial periods, and it is noticeable that the increase of population is not so great, and that there is a loss of population by migration—the emigration exceeding the immigration.

TABLE III.

Years.	Population.	Increase on previous Census.		Migration Loss.	Natural Increase.
		Numerical.	Per cent.		
1851 ...	17,927,609				
1861 ...	20,066,224	2,138,615	11·93		
1871 ...	22,712,266	2,646,042	13·19		
1881 ..	25,968,286	3,256,020	14·34	169,962	3,425,982

Sex-Constitution.—If we refer back to Table I. we see that the number of males has always exceeded that of females, and Table IV. shows the proportions existing at the various census periods. It also shows the proportions existing in England and Wales; and it thus appears that instead of the males being in excess, females preponderate.

TABLE IV.

Colony.		England and Wales.	
Year.	Males to 100 Females.	Year.	Males to 100 Females.
1844	121		
1846	130	1841	95·8
1851	124	1851	
1855	103	1851	95·5
1861	105	1861	
1866	109	1861	94·9
1871	105	1871	
1876	107	1871	94·8
1881	114	1881	
1889 (estimated) ..	104		

Referring to the colony, it will be seen that the proportion has varied considerably at the different years. The difference between males and females was greatest in the early days of the colony, and again suddenly in 1881; and these periods are found to be coincident to some extent with great increases in the population. Sudden increases of population are due principally to immigration, and it will be seen later that immigrants consist largely of adult males. The native-born population is almost equally divided between males and females—the latter, in fact, slightly preponderating, as shown in the following table, while the immigrant population has a very large excess of males over females. This holds in regard to immigrants from every country except Ireland, and the reason of this exception is that immigrants in this case are largely made up of female domestic servants. In the case of other countries, the immigrants are, as already stated, mostly young adult males; and as comparatively few of their countrywomen come with them, it follows that these immigrants must intermarry with native-born women, and this fact must have an important bearing on the race. Table V. shows the birthplaces of the population, with the sex-constitution at the date of the 1881 Census.

TABLE V.

Birth Place.	Total.	Males.	Females.
South Australia	163,507	81 750	81,757
England	57,540	32,901	24,639
Wales	1,611	932	679
Scotland	10,637	6,028	4,609
Ireland	18,246	9,060	9,186
Australian Colonies and New Zealand	9,566	5,236	4,330
Other British possessions	1,348	903	445
Germany	8,801	5,234	3,567
France	293	213	80
Austria	180	134	46
Hungary	26	24	2
Russia	91	76	15
Poland	133	83	50
Italy	141	133	8
Spain	26	19	7
Portugal	28	27	1
Belgium	41	32	9
Sweden and Norway	765	740	25
Switzerland	194	153	41
Holland	76	66	10
Denmark	264	237	27
China	347	347	....
Other Foreign States	901	666	235
Born at Sea	702	345	357
Unspecified	...	...	....

It should be stated that in the corporate towns the females exceed the males; the total populations of these towns being in 1881 equal to 87,465, of which 42,979 were males and 44,486 females. This is, doubtless, owing to the fact that immigrants tend to go into the country, while the towns are peopled chiefly by native-born population.

Age-constitution of the Population.—This is both interesting and instructive, and the main facts are shown in the following tables, which require little explanation. Taking, in the first place, the age of twenty-one as a dividing line, because this division can be carried back to the beginning of the colony (while smaller divisions of age cannot, on account of a want of correspondence in the age-groups previous to 1866), Table VI. shows the percentages thus :—

TABLE VI.

Census Years.		Under 21	Over 21	Census Years.		Under 21	Over 21
1844	Total ...	51·64	47·37	1861	Total ...	54·33	45·50
	Males ...	26·44	28·40		Males ...	27·04	24·15
	Females ...	25·19	18·97		Females ..	27·28	21·34
1846	Total ...	50·69	48·99	1866	Total ..	54·27	45·47
	Males ...	26·15	30·43		Males ...	27·23	24·82
	Females ...	24·54	18·50		Females ..	27·04	20·65
1851	Total ...	48·27	50·68	1871	Total ..	56·19	43·71
	Males ..	24·35	31·08		Males ...	28·16	23·16
	Females ...	23·92	19·60		Females ...	28·02	20·54
1855	Total ...	51·72	47·53	1876	Total ...	55·21	44·72
	Males ...	25·23	25·70		Males ...	27·67	24·11
	Females ...	25·49	21·83		Females ..	27·54	20·61
				1881	Total ...	51·54	48·42
					Males ..	25·83	27·59
					Females ...	25·71	20·83

Looking at the total population, we see that in the earlier years—up to 1855—the proportions of those under and over 21 years of age approximate. After 1855 they differ more markedly—the proportion of those under 21 being greater—until 1881, when they again approximate. This is probably accounted for by the fact that the early settlers were chiefly adults with comparatively few children; but as time went on the natural increase outweighed the migration increase (as has already been shown), and the population under 21 preponderated in a greater degree. The approximation in 1881 is also due in part to the sudden migration increase which took place in the previous intercensal period (already referred to), and probably in part to the accumulation of old people beginning to make itself felt. Looking now at the relation of males to females, we find that they approximate each other more closely under than over 21, because the former period is more under the influence of natural increase than migration increase. Over 21 the males preponderate largely over the females. It has been seen that in 1881 the total population under and over 21 approximates more closely than at the few preceding census years, and this appears to be owing to a decided increase in the males over 21—thus pointing to an intercensal increase by immigration. Table VIII. shows the percentages of the population at smaller age-groups. These can only be shown complete as far back as 1866, and partially to 1861, as the age-groups on the previous censuses do not correspond. A noteworthy point is the gradual increase of the proportions living at the later period of life, while the apparent decrease in the earlier age-groups is probably explained by the increasing proportions at the succeeding age-groups. It is also seen that the males and females approximate more closely in the first four than in the following age-groups, and that the males preponderate more in the middle than the last age-groups, while the females exceed the males in only one group (15 to 20).

England and Wales.

TABLE VII.

1881	Total	13·6	12·0	10·8	9·8	9·0	14·6	11·3	8·4	5·9	3·3	1·3
	Males ..	6·7	6·4	5·4	4·9	4·3	7·1	5·4	3·9	2·8	1·1	·6
	Females ..	6·7	6·1	5·4	4·9	4·7	7·6	5·9	4·4	3·1	1·8	·8

Table VIII.

Census Years.		0–5	5–10	10–15	15–20	20–25	25–35	35–45	45–55	55–65	65–75	75–
1861	Total	19·1	14·2	10·2	..	..	..	..	..	..	..	..
	Males ...	9·6	7·0	5·2	..	..	..	..	..	..	..	..
	Females ...	9·4	7·2	5·0	..	..	..	..	..	..	..	..
1866	Total	17·9	14·8	10·9	8·5	9·2	15·7	10·9	6·8	3·3	1·0	·25
	Males	9·0	7·5	5·4	4·2	4·9	8·3	6·1	3·8	1·8	·5	·14
	Females ...	8·9	7·3	5·4	4·3	4·3	7·4	4·8	2·9	1·4	·4	·11
1871	Total	16·9	15·3	12·7	9·4	7·6	14·2	10·8	7·0	3·7	1·4	·33
	Males ...	8·5	7·6	6·4	4·6	3·8	7·4	5·7	3·9	2·0	·7	·18
	Females ...	8·3	7·6	6·2	4·8	3·8	6·8	5·1	3·0	1·6	·6	·15
1876	Total	14·8	14·4	12·8	11·0	8·9	13·6	10·6	7·1	4·1	1·74	·49
	Males ...	7·4	7·2	6·4	5·4	4·6	7·4	5 6	3·9	2·2	·9	·26
	Females ...	7·4	7·1	6·4	5·5	4·3	6·2	5·0	3·2	1·8	·7	·24
1881	Total	14·8	12·4	11·5	10·6	10·9	15·6	10·6	6·9	3·9	1·78	·56
	Males ...	7·5	6·2	5·7	5·2	6·0	9·2	6·0	3·7	2·1	·9	·29
	Females ...	7·3	6·1	5·7	5·3	4·9	6·3	4·5	3·1	1·7	·8	·27

Table VII. enables a comparison to be made with England and Wales in 1881, and we see that there is a larger proportion living after 35 than in the colony; so that the population of the colony may be said to be younger than that of England and Wales.

Urban and Rural distribution of population.—The total area of the colony being 380,070 square miles, or 243,244,800 acres, and the population in 1881 being 279,865, represent a density of 869 acres, or $1\frac{1}{3}$ square miles per person. Of course, a large part of the country being uninhabited, this proportion has no relation to the settled districts; but even in these, the population is so scattered that any statement as to density has little value. If, however, we take Adelaide as the most dense aggregation of population in the colony, we find that there are only 12·1 persons to the acre—8·3 in the least and 16·4 in the most populous ward.

Taking the urban population to be represented by the total of the corporate towns (which vary individually from 800 to 45,000), the census of 1881 shows it to amount to 87,465. This leaves a

rural population of 192,400. This proportion is contrasted with that of England and Wales in Table IX.

TABLE IX.

——	Colony.	England and Wales.
Urban Population	31·2	66·6
Rural „	68·7	33·4

It thus appears that the relationship is reversed, although in the case of England and Wales, populations under 3,000 are excluded from urban districts.

The occupations of the people at the time of the 1881 census are shown in Table X. A large number is stated to be engaged in commerce, trade, and manufactures; but those which are most injurious to health are conspicuous by their absence. Mining embraces almost solely gold, silver, and copper mining; coal mines do not exist in the colony. Speaking generally, it may be stated that the occupations of the people are not unhealthy, and that they are conducted under fairly sanitary regulations. The eight hours' system is as a rule adopted, although not enforced by Act of Parliament.

TABLE X.

Occupations.	Number.
Commerce, Trade, and Manufactures	46,107
Mining	2,196
Agricultural, Horticultural, and Pastoral Pursuits	34,820
Labourers (branch undefined)	8,659
Domestic Servants	10,340
Learned Professions, Fine Arts, Literature, &c.	4.153
General and Local Government	1,871
Maintenance at Public Cost	1,923
Miscellaneous Pursuits	3,138
Independent Means	729
Residue of Population	165,920

This apparently large residue is made up of wives, children, scholars, visitors, &c.

Education is practically under State control. It is secular, compulsory, and free when the parents cannot afford to pay the fees. The curriculum embraces reading, writing, spelling, arithmetic, geography, grammar, composition, English history, drill, needlework (for girls); while of late attention has been directed to technical education and science lessons. The following extract is taken from the regulations made by the Minister of Education:—"The object of the education system is to develop the intellectual and moral faculties of the children. It is not sufficient merely to give instruction, but the aim of every teacher should be to train his pupils in habits of cleanliness, industry, punctuality, obedience, truthfulness, honesty, and consideration for others." This must have an immense effect on the sanitary progress of the colony, especially as there are very few districts that are not within reach of a school. In addition to the State schools there are several private schools which afford a high-class education; and the system is completed by the university with its courses of arts, law, medicine, science, and music.

Food.—The following table, taken from one prepared by the Government Statist of New South Wales, will afford a good idea of the staple food of the people, although it refers specially to the colony named.

TABLE XI.

Articles of Consumption.	Colony.	Great Britain.
Grain	310 lbs.	330 lbs.
Meat	278 ,,	105 ,,
Sugar	95 ,,	72 ,,
Salt	36 ,,	40 ,,
Butter	16 ,,	26 ,,
Potatoes	221 ,,	315 ,,
Tea	121 ozs.	73 ozs.
Coffee	11 ,,	15 ,,

It may be pointed out, without discussing whether it constitutes an error of diet or otherwise, that the amount of meat consumed in the colony is largely is excess of that in Great Britain; this is doubtless owing to its cheapness. It will also be seen that the tea and sugar consumed in the colony is also greater, while the other articles mentioned are less.

To sum up a few remaining facts in regard to the population, it may be said that the general conditions are favourable to health.

There is no overcrowding (as already seen); no poverty, no hardships (climatic or other) to be endured except in the far outlying districts, and that only affecting a very few. Then, much attention is directed to sports and athletic exercises; public holidays are frequent; and the climate is such as to allow a great deal of time to be spent out of doors. Thus, the general insanitary conditions which we have seen to exist are to some extent counterbalanced by other conditions of a more favourable character.

Having now considered the various surroundings and the relations of the population generally, it might be interesting to inquire into their effect on the native-born race that is in process of development; but it is doubtful whether sufficient facts are at our disposal to enable us to come to any conclusion. Dr. Verco, of Adelaide, referred to this matter in his inaugural address as President of the First Intercolonial Medical Congress of Australasia. He says: "Does anyone ask for evidence that these causes do work? I have measured 300 South Australian immigrants from the Old World. They stand 5 feet 7·13 inches, and weigh 146·58 lbs. I have contrasted them with 250 South Australians born in the colony. They average 5 feet 8·21 inches and weigh 146·42 lbs. Our native population are, therefore, about an inch taller and within a fraction of a pound the same weight. What is the significance of these facts? That our southern climate, our social circumstances, our mode of life, are altering the physical constitution of the healthy man, the growing child, and giving him a taller and more slender form. Whether this be a development or a degeneration I will not say, but it is an evidence of the modifying influences that are at work."

Births.

The birth-rate of the colony has varied from year to year, but has always been high. The highest was 48·2 in 1857, and the lowest 32·7 in 1889. Since 1885 the birth-rate has been steadily declining. Table XII. shows the birth-rate of the colony contrasted with that of England and Wales:—

Table XII.

Year.	Colony.			England and Wales.		
	Birth Rate.	Marriage Rate.	Death Rate.	Birth Rate.	Marriage Rate.	Death Rate.
1844–50	36·0	7·4	14·2			
1851–60	43·5	9·9	15·5			
1861–70	42·9	8·3	15·5			
1871–75	37·6	7·6	15·8	35·5	8·5	
1876–80	38·2	8·8	14·9	35·4	7·6	
1881	38·5	8·3	14·4	33·9	7·5	18·9
1882	38·0	8·8	15·4	33·7	7·7	19·6
1883	38·0	8·6	15·0	33·3	7·7	19·3
1884	39·0	8·4	15·7	33·3	7·5	19·5
1885	39·0	7·9	12·9	32·5	7·2	19·0
1886	36·5	6·4	13·8	32·4	7·0	19·3
1887	35·0	6·4	12·7	31·4	7·1	18·8
1888	33·8	6·7	12·0	30·6	7·1	17·8
1889	32·7	6·5	11·1	30·5	7·3	17·9

It thus appears that the birth-rate of England and Wales is lower than that of the colony. The constant stream of young adult immigrants was doubtless the chief factor in causing the high birth-rate, and the decrease in recent years is in great part the result of the exodus of young adult population to the Barrier silver fields (which are situated just outside the colony), and probably in part to the period of depression through which the colony has been passing. The effect of a high birth-rate is well known to raise the proportion of children in the population, and if continued, of those under middle age as well. We have already shown that this result obtains. It has also an effect on the death-rate, which will be considered later.

The following table shows that the proportion of male to female births is greater for the colony than for England and Wales :—

TABLE XIII.

Year.	Births of Males to 1,000 of Females.	
	Colony.	England and Wales.
1876–80	1,048	1,037
1881	1,064	1,039
1882	1,063	1,038
1883	1,032	1,035
1884	1,043	1,041
1885	1,015	1,040
1886	1,014	1,038
1887	1,097	1,039
1888	1,098	1,033
1889	1,050	1,038

MARRIAGES.

The marriage-rates are shown in Table XII. They resemble the birth-rates, inasmuch as they are higher in earlier than later years; and doubtless the same causes affected both. These have already been stated.

Deaths.

The conditions described in the preceding pages are, on the whole, conducive to a low mortality. The climatic conditions were seen to be favourable to health, and to counteract to some extent the effect of insanitary surroundings. The age-constitution and other conditions (with one exception) of the population also favour a low death-rate. The exception referred to is the sex-constitution—as will be seen afterwards. Further, the continuous high birth-rate which we have shown to exist is usually accompanied—other things being equal—by a low death-rate. Accordingly, we may expect to find the death-rate of the colony to be low rather than high. Table XII. shows that this has been fairly well maintained. The death-rate has varied considerably from year to year, as might be expected in so small a population. The highest was 20·03 in 1875, the lowest 11·10 in 1889. It may be mentioned in regard to this high death-rate, and as an illustration of how easily the rate is affected in a small community, that in 1875 an epidemic of scarlet fever was at its height, while one of measles was at the same time on the decline. Dividing the total years of the colony's history into periods, we get the death-rates as shown in the following table :—

Table XIV.

Years.	Death Rate per 1,000
1846–55	16·22
1856–65	15·41
1866–75	15·53
1876–85	14·83
1886–89	12·45

Thus there has been a progressive decrease in the death-rate. Its relation to sanitary progress will be considered later.

The following table shows the death-rates of age-groups stated as per 1,000 living at these periods for the years 1880 to 1889, and also a comparison between the colony and England and Wales. It shows that the mortality of the age-groups between 5 and 45 is below that of all ages. Hence, it follows that a community like the colony, which has a large proportion of the population between these

ages, ought to have a lower death-rate than England and Wales. It will be seen that at no age-group does the mortality of the colony exceed that of England and Wales. Table XV. further shows that the decrease which has occurred in recent years in the death-rate of all ages is due to a marked decrease in that of the group 0–5, and a slight decrease in those of the others up to the last two.

Death-Rates at Age-Groups.

TABLE XV.

Year.	Population.	All Ages.	0–5	5–10	10–15	15–20	20–25	25–35	35–45	45–55	55–65	65–75	75–
1880	267,573	14·7	49·2	3·6	2·6	4·2	5·6	6·4	10·5	13·7	22·5	48·9	103·4
1881	286,324	14·4	45·3	3·4	2·4	3·8	4·4	7·1	10·1	15·4	22·8	49·4	106·6
1882	293,509	15·4	49·7	2·7	2·5	4·7	5·3	7·8	9·8	14·4	26·3	47·2	115·6
1883	293,937	15·0	50·9	3·4	2·4	3·3	5·7	6·8	9·9	15·2	24·9	58·6	99·6
1884	303,426	15·7	51·5	4·6	2·8	4·3	5·9	7·9	9·5	13·9	27·4	58·8	131·8
1885	308,648	12·9	39·6	3·4	1·8	4·0	4·5	6·4	8·1	12·9	23·6	52·2	136·2
1886	305,561	13 8	41·0	3·4	1·7	3·5	4·6	7·9	9·9	13·3	26·9	59·7	158·9
1887	308,836	12·7	35·1	3·0	1·7	4·1	4·9	7·0	9·4	12·7	25·3	55·8	177·5
1888	310,886	12·0	30·0	4·3	1·9	3·6	4·2	6·8	8·5	13·8	25·7	60·7	168·3
1889	315,402	11·1	28·9	2·9	1·8	3·2	3·8	5·6	6·9	12·3	24·5	60·3	160·2
1880 } 1889 }	Colony	13·8	42·1	3·4	2·1	3·8	4·8	6·9	9·2	13·7	24·9	55·1	135·8
1880 } 1885 }	Colony	14·7	47·4	3·5	2·3	4·0	5·1	7·2	9 4	14·3	25·0	53·2	117·9
1880 } 1885 }	England and Wales.	19·3	55·0	5·7	3·2	4·6	5·9	8·0	11·8	17·3	30·7	64·1	209·1

The percentage of the total number of deaths at these age-groups is shown in Table XVI. for the years 1880–89; but as the populations are not taken into account, the result is not of much value. It serves, however, to show that nearly half of the total number of deaths occurs under 5 years of age, and that up to 25 the number of deaths of females exceed those of males.

TABLE XVI.

1880–1889. Deaths.	0–5	5–10	10–15	15–20	20–25	25–35	35–45	45–55	55–65	65–75	75–85	85–
Total ...	45·6	3·2	1·8	3·0	3·9	8·0	7·1	6·9	7·2	7·2	4·5	1·1
Males ...	44·0	3·0	1·7	2·7	3·6	8·0	7·4	7·7	8·0	7·7	4·5	·99
Females ...	47·5	3·4	1·9	3·3	4·3	8·0	6·7	6·0	6·1	6·5	4·4	1·3

Infantile Mortality.—We have already seen that the death-rate at the age group 0–5 has decreased considerably in recent years, and that it compares favourably with that of England and Wales. The rate under one year of age will now be considered, and it will be stated as per 1,000 births. Table XVII. shows this infantile mortality as far back as it can be ascertained.

TABLE XVII.

Year.	Infantile Mortality per 1,000 Births.
1873	139
1874	171
1875	182
1876	153
1877	140
1878	157
1879	122
1880	135
1881	127
1882	152
1883	146
1884	134
1885	113
1886	126
1887	111
1888	96
1889	94
1873–89	134
1873–84	146
1885–89	108

It is doubtful whether the data on which these rates are calculated are reliable previous to 1885; because formerly many deaths were registered by the District Registrars under the heading one year of age when they should have been returned as between 1 and 2. This, of course, would tend to raise the infantile mortality; so that if an error does exist, it is in the direction of increasing the death-rate. Since 1885, however, greater care has been exercised under instructions from the Registrar-General, and consequently the rate may be regarded as accurately stated after that date. The preceding Table shows that the mean rate for the years 1873–89 is 134; for 1873-84, 146; and for 1885–89, 108. It is thus evident that there has been a marked decrease in recent years—probably accounted for in part

by the elimination of the error referred to. If we compare the infantile mortality with that of England and Wales, as shown in Table XVIII., we find that for the period 1873–84 (when the error tells against the colony) they are almost equal; while in recent years it is much less for the colony than for England and Wales. This disposes of the assertion frequently made that South Australia is exceptionally unfavourable to infant life.

TABLE XVIII.

Year.	Infantile Mortality for 1,000 Births in England and Wales.
1877–86	142
1887...	145
1888...	136
1889...	144

Mortality in regard to Sex.—Owing to the incompleteness of the Registrar-General's Returns, Table XIX. shows this for only two years.

TABLE XIX.

Year.	Death-Rate.		
	Total.	Males.	Females.
1888	12·09	13·45	10·68
1889	11·10	12·23	9·92
Mean of ...	11·59	12·84	10·30

The data are very meagre, but it shows that the death-rate of males is higher than that of females; and as males preponderate in the population the tendency is to raise the general death-rate, as already stated.

Seasonal Mortality.—The following Table gives the total number of deaths in each month, and the percentage of the monthly average which it represents. The first part of the Table is stated for the colony as far back as it is able to go; and the latter parts contrast

the colony with the city of Adelaide for a period which goes as far back as the data for Adelaide extend.

TABLE XX.

Month.	Colony. 1861–89.		Colony. 1870–89.		Adelaide. 1870–89.	
	Total Deaths.	Percentage of Monthly Average.	Total Deaths.	Percentage of Monthly Average.	Total Deaths.	Percentage of Monthly Average.
January ...	9,259	116·1	7,345	120·6	1,681	122·3
February ...	8,026	102·2	6,290	103·3	1,355	98·5
March ...	9,422	120·0	7,232	118·8	1,573	114·3
April ...	9,056	115·3	6,974	114·6	1,491	108·4
May ...	8,625	109·8	6,548	107·6	1,358	98·8
June ...	7,642	97·3	5,594	91·8	1,242	90·3
July ...	6,873	87·5	5,392	88·6	1,252	91·0
August ...	6,793	86·5	5,268	86·5	1,234	89·7
September	6,141	78·2	4,789	78·6	1,073	78·0
October ...	6,037	76·9	4,835	79·4	1,125	81·8
November	7,227	92·0	5,719	93·9	1,441	104·8
December...	9,091	115·8	7,041	115·7	1,668	121·3
Monthly Average	7,849·3	100·0	6,085·5	100·0	1,374·0	100·0

The chart at page 64 shows these results graphically; but it must be remembered that the Table deals with total deaths, and that the months are unequal in number of days. It is seen that there is a well-defined curve which attains its lowest point in October and its highest in March; this holds good for the colony for the period 1861–89, but for the shorter period, 1870–89, there is some variation from it, both for the colony and for Adelaide—the highest point being reached in January and the lowest in September. But in all we find that from December to May (inclusive) the number of deaths is above, while from June to November (inclusive) the number is below the monthly average. If we compare this curve with the corresponding curves of certain meteorological conditions, we find the following relations. The curve of monthly mean temperature resembles the death-rate very closely—being above the mean annual temperature from November to April (inclusive), and below it from May to October (inclusive); while, on the other hand, the curves of

rainfall and of barometric pressure are as opposite to the death curve as possible—being at their lowest points when the latter is at its highest, and *vice versâ*. Without discussing this matter more particularly at present, it may be stated broadly that the hot dry summer months correspond with the rise, and the cold wet winter months with the fall of the death curve. Hot and cold, and dry and wet are comparative terms. Moreover, the atmosphere may be dry, and yet the soil may be moist; and the soil may be warm while the atmosphere is comparatively cool: so that the above general statement must be accepted with qualifications.

Causes of Death.

The Registrar-General's Annual Report for 1889 gives a return (No. 18) showing the number of deaths from each cause during the ten years 1880–89, arranged in order of fatality. From this it appears that Diarrhœal diseases (3,680) and Phthisis (3,181) are the two most fatal diseases, and approach each other in number very closely. Taking these years individually, sometimes one disease heads the list, sometimes the other. The other diseases which may be specially noted are those included under the term "zymotic." Enteric Fever (1,167) and Diphtheria (878) stand high in the order of fatality, and would be considerably higher if Simple and Remittent Fevers were included with the former and Croup with the latter. If these were added, the latter (1,559) would exceed the former (1,346) in number of deaths. These two diseases are fairly constant in the individual years of the decennial period. Whooping Cough (513), Measles (256), and Scarlet Fever (270) stand well up on the list; but very few deaths from these causes have occurred in the latter half of the period. The only other disease which will be referred to is Hydatid Disease; and it may be noted that it caused 90 deaths during the decennium—13 being in 1888 and 11 in 1889.

The following Tables will refer to these diseases (with the exception of Hydatid disease, which is considered later). Table XXI. shows the number of deaths at age-groups for the years 1880–89—thus indicating at what period of life these diseases are most fatal :—

TABLE XXI.

—	All ages.	0–1	1–2	2–5	5–10	10–15	15–20	20–25	25–35	35–45	45–55	55–65	65–75	75–
Measles	256	72	95	56	23	3	1	...	5	...	...	1	...	...
Scarlet Fever ...	270	36	61	117	39	8	3	5	1	...	...	...	...	...
Influenza	29	16	1	1	...	...	...	1	1	2	...	3	2	2
Whooping Cough	513	355	92	54	11	1	...	...	...	...	...	...	...	...
Diphtheria... ...	876	72	117	399	236	30	6	6	7	1	...	1	1	...
Croup	681	103	164	327	83	3	...	1	...	...	...	...	...	...
Enteric Fever* ...	1,325	59	34	102	125	131	213	236	255	84	45	30	11	...
Diarrhœa* ...	3,680	2623	508	109	22	14	13	13	45	60	73	83	68	49
Phthisis	3,181	40	21	25	31	53	319	531	992	570	364	170	54	8
Tubercular Meningitis	469	180	90	87	63	19	10	6	8	2	2	...	...	...

TABLE XXII.

Year.	Per 1,000.	Mortality per 1,000,000.											
	Total Death Rate.	Measles.	Scarlet Fever.	Influenza.	Whooping Cough.	Diphtheria.	Croup.	Diphtheria plus Croup.	Enteric Fever.*	Diarrhœa.*	Phthisis.	Total Tubercular Diseases.
1858 ...	16·2	17	131	78	245	96	560	667	744	2,260	1,060	1,594
1859 ...	15·9	8	174	...	506	509	605	1,115	779	2,231	904	1,360
1860 ...	18·9	8	81	226	484	858	575	1,434	1,028	2,811	1,037	1,442
1861 ...	15·6	884	15	47	302	526	595	1,123	645	2,088	1,091	1,322
1862 ...	14·6	796	153	30	97	421	199	620	497	1,385	1,079	1,508
1863 ...	16·4	...	2,128	88	280	775	258	1,034	524	1,101	871	1,160
1864 ...	18·2	...	3,631	49	448	762	313	1,075	405	1,224	733	989
1865 ...	14·7	...	101	40	13	732	298	1,031	685	1,486	800	1,051
1866 ...	17·5	...	12	95	...	229	191	421	1,628	2,043	1,123	1,482
1867 ...	17·3	659	52	5	559	994	423	1,428	806	1,642	971	1,342
1868 ...	14·5	98	52	5	879	613	387	1,000	445	1,151	971	1,457
1869 ...	12·5	...	11	56	79	397	397	714	357	1,100	856	1,134
1870 ...	14·0	5	49	44	...	640	220	861	640	1,231	988	1,286
1871 ...	12·9	...	120	32	...	370	234	605	376	1,778	850	1,145
1872 ...	15·3	...	137	5	776	556	323	880	360	2,020	774	1,076
1873 ...	13·6	5	155	20	187	317	228	545	421	1,263	795	1,096
1874 ...	17·2	1,408	323	5	40	357	306	664	619	1,756	900	1,363
1875 ...	20·0	363	2,343	48	9	358	237	595	556	1,593	1,007	1,288
1876 ...	16·3	23	1,125	41	46	221	249	470	618	1,278	1,042	1,333
1877 ...	14·0	4	307	4	151	129	147	277	437	1,462	878	1,138
1878 ...	15·4	8	112	16	349	305	213	518	494	1,479	1,073	1,370
1879 ...	14·0	3	277	7	158	316	331	647	416	1,079	1,044	1,356
1880 ...	14·7	33	392	22	142	384	347	732	298	1,334	1,035	1,425
1881 ...	14·4	251	174	6	94	202	227	429	342	1,292	956	1,309
1882 ...	15·4	37	115	6	146	228	337	565	555	1,642	1,161	1,683
1883 ...	15·0	40	81	17	435	166	367	534	517	1,736	1,064	1,585
1884 ...	15·7	458	95	...	174	365	280	645	517	1,443	1,064	1,446
1885 ...	12·9	19	12	9	291	330	278	509	492	1,082	994	1,389
1886 ...	13·8	9	42	16	304	307	91	399	382	1,073	1,109	1,495
1887 ...	12·7	6	22	...	97	191	90	281	534	1,168	1,143	1,515
1888 ...	12·0	3	9	9	29	447	128	571	389	717	1,174	1,437
1889 ...	11·1	3	3	9	6	345	123	469	443	970	916	1,236

* *Enteric fever* includes *simple, continued,* and *remittent fevers; Diarrhœa* includes *dysentery* and *cholera (simple).*

Mortality of Certain Special Diseases.

The preceding table shows the annual death-rates of these diseases per million for the years 1858–89. If charts be constructed like that at page 67, it will be seen that the cyclical waves have various characters. Some have a sudden rise and an equally sudden fall, and either disappear entirely, or nearly so, for a long period; such are measles, scarlet fever, and whooping cough, and may be regarded as epidemic diseases. Others have a rise and fall varying in extent, but never disappearing. The total wave comprises three or four years, and is not so high as the preceding. Such are enteric fever, diphtheria and diarrhœa, and may be regarded as endemic diseases. Another type of wave is seen in the case of phthisis, where the variation is comparatively slight. This cyclical character of these diseases leads us to consider how far meteorological, and how far sanitary, conditions have influenced them. The former relationship will be considered under the individual diseases; and before proceeding to a consideration of the latter, it may be of advantage to compare the preceding table with the following, which shows the corresponding mortalities for England and Wales:—

TABLE XXIII.

Year.	Measles.	Scarlet Fever.	Whooping Cough.	Diphtheria.	Typhus Fever.	Enteric Fever.	Ill-defined Fever.	Diarrhœal Diseases.	Phthisis.	Total Tubercular Diseases.
1861–70 ...	440	972	527	185	...	885	...	1,076	2,475	3,259
1871–80 ...	378	716	512	121	...	484	...	935	2,116	2,878
1881	280	548	416	121	21	212	44	570	1,825	2,530
1882	481	520	577	151	36	229	38	664	1,844	2,573
1883	348	472	391	158	33	227	36	610	1,870	2,577
1884	416	399	422	185	12	234	28	1,001	1,812	2,550
1885	526	231	477	163	12	173	24	498	1,752	2,406
1886	431	215	464	147	9	182	22	907	1,718	2,444
1887	594	278	398	157	7	182	18	733	1,591	2,249
1888	341	222	428	168	·6	169	15	447	1,541	2,183
1889	508	231	421	185	·5	173	14	635	1,542	2,213

A comparison of these two tables shows that the mortality of diphtheria, enteric fever, and diarrhœa is very much greater in the colony than in England and Wales; while the mortality of phthisis and tubercular diseases generally is very much lower. In comparing measles, scarlet fever, and whooping cough, the point which is most

evident is that the variations in the mortality are not nearly so great in England and Wales as in the colony. It may be inferred that phthisis has not found the conditions necessary for its development; that those diseases which we have agreed to call endemic have found a favourable soil; and that the epidemic diseases require to be introduced from without previous to an outbreak. These points will be referred to again.

Effect of Sanitation on the Death-Rate.

TABLE XXIV.

Mortality Stated as per 1,000.	1858–65.	1866–73.	1874–76.	1877–82.	1883–8[illegible].
Total death-rate	16·37	14·75	17·89	14·68	13·37
Measles	·214	·095	·508	·056	·076
Scarlet fever	·801	·073	1·263	·229	·037
Influenza	·069	·032	·031	·010	·008
Whooping cough	·296	·310	·031	·173	·190
Diphtheria	·584	·514	·312	·260	·307
Croup	·425	·300	·264	·267	·193
Diphtheria plus croup ...	1·012	·816	·576	·528	·499
*Enteric fever...	·663	·629	·597	·423	·467
*Diarrhœa	1·823	1·528	1·542	1·381	1·169
Phthisis	·946	·146	·183	1·024	1·066
Total tubercular diseases ...	1·303	1·252	1·328	1·380	1·443

* *Enteric fever* includes *simple continued* and *remittent fevers*; *Diarrhœa* includes *dysentery* and *cholera* (*simple*).

It has already been pointed out that the Public Health Acts belong to the years 1873 and 1876, and the intervening period may be taken as a dividing line for purposes of comparison. In the preceding table this period is placed by itself, as the influence of the Health Acts could not be apparent within so short a time after the passing of the first Act; and in order to test the progress further, the years before and after these dates are divided respectively into two periods. It thus appears that there has been a gradual decrease in the total death-rate except during the period 1874–76. It is also seen that during this period the mortality of measles and scarlet fever is very high as compared with the remaining periods; and this is doubtless the explanation of the high total death-rate. As these diseases are inappreciably affected by sanitary progress, it is only fair

to discount their influence; and if we leave this period out of account, we find that the decrease in the total death-rate is slight in the first but marked in the second subsequent group as compared with the preceding groups of years. Taking now those diseases which are usually regarded as sanitary indices—namely, diphtheria, enteric fever, and diarrhœa—it is seen that there is a marked decrease in the death-rates of the last two periods compared with the first two. In the case of diphtheria and enteric fever, the decrease is apparently less in the last period than in the one immediately preceding.

But it will be shown later that the increased mortality of diphtheria in recent years is probably owing to deaths which were formerly ascribed to croup being returned as due to diphtheria; so that a more accurate idea will be obtained by adding the two together, and if this be done the decrease will be seen to be progressive. In regard to enteric fever, the increased mortality of the last few years is doubtless due to the effect of several recent mining discoveries, as already pointed out. In fact, so much is enteric fever influenced by suddenly occurring local and external conditions that I do not regard it as a reliable index of the sanitary state of the the colony. For instance, the Barrier mining district (Broken Hill), which is outside the colony, but in immediate communication with it, sent all its cases of enteric fever to Adelaide and other South Australian towns for treatment, and thus appreciably increased the mortality of this disease in the colony. On this account I look upon diphtheria and diarrhœa as the most reliable indices of sanitary progress, because they are less liable to be affected by external influences. The table shows that the mortality of diarrhœa has decreased markedly and progressively. On the other hand, phthisis and tubercular diseases show a progressive increased death-rate; this is probably partly due to more accurate diagnosis, and partly to external influences, which will be referred to again.

Thus, on the whole, we may conclude that the Public Health Acts have been beneficial in their action.

Effect of the Deep Drainage System in Adelaide on the Death-rate.—It has already been pointed out that, previous to the adoption of this system, the sanitary condition of Adelaide was unsatisfactory, and that since it has been in operation the mprovement has been very great. It remains to be seen how the death-rate has been affected by it. In order to properly estimate the result, various circumstances must be taken into account. For instance, Adelaide

contains a large general hospital and other public institutions; hence, it will be necessary to make corrections in the death-rate for these, if possible. Then the rest of the colony must be considered, to ascertain whether the decrease (if any) in the death-rate of Adelaide may not be coincident with a decrease throughout the colony unconnected with the deep drainage system; or whether the general decrease may not to some extent be the result of the improved sanitary condition of Adelaide. The suburbs would be the part most directly affected by the sanitary improvement of the city; but, unfortunately, the data do not exist sufficiently far back to enable the suburbs to be contrasted with Adelaide. In the following tables these points are taken into account as much as possible. The deep drainage system was begun in 1882, and practically finished in 1884; and this period (1882–84) is taken as a central one in order to facilitate comparison between periods preceding and following:—

TABLE XXV.

———	1877–81.	1882–84.	1885-89.
Colony	14·5	15·3	12·5
*Adelaide	25·5	24·5	19·0
Colony minus Adelaide	12·4	13·3	11·4

* Deaths in public instituttions are included.

TABLE XXVI.

———	1877–81.	1882–84.	1885–89.
Colony	14·5	15·3	12·5
*Adelaide	21·5	21·1	15·9
*Colony minus Adelaide	13·0	14·3	11·9

* Deaths in public institutions of persons not usually resident in the city are excluded from Adelaide and added to Colony minus Adelaide.

Table XXVI. is the more instructive on account of the correction for public institutions being made.

It will be seen that, during the second period, there is a slight decrease in the death-rate for Adelaide and an increase in that for the rest of the colony; the converse might have been expected, as

the drainage works were being constructed during that period. Looking at the third period, we see that there is a marked decrease in the death-rate both for Adelaide and for the rest of the colony, but much more marked for Adelaide than for the rest of the colony.

In regard to *Zymotic Mortality*, available data extend back only to 1879, and the deaths in public institutions cannot be discriminated. Although this latter circumstance to some extent vitiates the statistics, yet the factor of error is practically constant, and so may be disregarded for purposes of comparison. Further, the disease involved is only one—enteric fever—the others not being taken to hospital, as a rule, for treatment :—

TABLE XXVII.

Mortality is stated as per 1000.	1879-81.		1882-84.		1885-89.	
	*Adelaide.	Colony minus Adelaide.	*Adelaide.	Colony minus Adelaide.	*Adelaide.	Colony minus Adelaide.
Total death-rate	24·5	12·4	24·5	13·3	19·0	11·4
Diphtheria...	·41	·26	·34	·23	·30	·32
Croup	·31	·31	·43	·30	·10	·14
Diphtheria plus croup ..	·73	·57	·78	·54	·41	·47
†Enteric fever	·76	·28	1·11	·43	·73	·39
†Diarrhœa...	1·84	1·13	2·18	1·46	1·21	·96
Phthisis	2·84	·70	2·58	·84	2·56	·81

* *Aaelaide* includes *all deaths* in *public institutions.*

† *Enteric fever* includes *simple continued* and *remittent fevers*; *Diarrhœa* includes *cholera* (*simple*) and *dysentery.*

Phthisis is included in this and other tables for convenience sake. It thus appears from the above table that the mortality of all these diseases has decreased during the last period, and proportionately more so for Adelaide than for the rest of the colony. We have agreed to look upon diphtheria and diarrhœa as *the* sanitary tests, and, if we include croup with the former, we find that the decrease in the mortality of these two diseases is very much more marked for Adelaide than for the rest of the colony. It appears further that in the case of diphtheria plus croup, there

was during the second period an increased mortality for Adelaide, while there was a decreased mortality for the rest of the colony. There was also during this period an increased mortality of diarrhœa for Adelaide, with a nearly equal increase for the rest of the colony. As this period embraces the construction of the drainage works, it is probable that the upturning of the soil had some relationship to these increased mortalities. I think we are justified from the two preceding tables is assuming that the adoption of the deep drainage system has materially assisted in lowering the mortality of the city of Adelaide.

Urban and Rural Mortality.—In dealing with this part of the subject, the same division of population will be taken already adopted under the heading of Population, namely, the corporate towns as representing the urban, and the rest of the colony the rural population. It will be remembered that the former includes 31·2, and the latter 68·7 per cent. of the rural population, and that this is the converse of what holds good in the case of England and Wales. The same difficulty as occurred in the relation of Adelaide to the rest of the colony is met with here; or is rather accentuated, for several of the corporate towns contain public hospitals. As a rule, however, these institutions are small, and perhaps affect the total death-rate very slightly; so that if correction be made for Adelaide, a fair comparison will be obtained. Of the zymotic diseases, enteric fever is the only one which is likely to create an error, as many cases come into the hospitals from the country for treatment; hence, it will be desirable to disregard the disease altogether for purposes of comparison. In the following table the figures can only be given back to 1884:—

TABLE XXVIII.

1884-89.	Total Death Rate.	*Diphtheria.	*Enteric fever.	*Diarrhœa.	Phthisis.
†Corporate towns	17·58	·39	·60	1·29	1·75
Colony minus corporate towns ...	10·43	·28	·27	·83	·65

* In these *Tables, diphtheria* does *not* include *croup; neither* does *enteric fever* include *simple continued* or *remittent fevers;* nor *diarrhœa simple cholera.*

† *Including all deaths* in *public institutions.*

Table XXIX.

1884–89.	Total Death Rate.	*Diphtheria.	*Enteric fever.	*Diarrhœa.	Phthisis.
†Corporate towns	16·35	·39	·51	1·27	1·61
Colony minus corporate towns ..	11·16	·28	·32	·84	·73

* In these *tables diphtheria* does *not* include *croup; neither* does *enteric fever* include *simple continued* or *remittent fevers; nor diarrhœa simple cholera.*

† *Excluding all deaths in Adelaide public institutions* of persons *not usually resident in the city* from *corporate towns* and *adding them to the Colony minus corporate towns.*

Taking diphtheria and diarrhœa again as the sanitary tests, we see that their mortality is very much higher for the corporate towns than for the rest of the colony; and it is fair to infer that the aggregation of population results in conditions more favourable to the development of these diseases. The aggregation of population also tends to increase the total mortality. In regard to phthisis, it appears that the urban mortality is double the rural; but this is probably explained by the tendency of phthisical patients to come to towns for treatment (apart from hospitals), and on account of the general conveniences of life.

Relative Mortality of Corporate Towns.—It would be valueless to compare these towns individually, on account of the small numbers to be dealt with. Accordingly, I have divided them into three groups—(1) Adelaide, (2) Suburban Towns, and (3) the remaining Corporate Towns. In the following table, Adelaide is corrected as far as its public institutions are concerned; but the deaths so deducted cannot be credited to their proper places, so that the other towns (especially the suburban towns) receive the benefit of this in the following comparison. Data can only be obtained back to 1884 for the towns other than Adelaide; and it should be remembered that the period 1884–89 has afforded Adelaide the advantages of the deep drainage system.

TABLE XXX.

1884-89.	Total Death Rate.	*Diphtheria.	*Enteric fever.	*Diarrhœa.	Phthisis.
Adelaide (corrected)	16·6	·30	·51	1·24	2·11
Suburban towns	14·8	·48	·47	1·32	2·00
Other corporate towns	18·5	·35	·81	1·23	1·21

* *Diphtheria* does *not* include *croup; enteric fever* does *not* include *simple continued* and *remittent fevers; diarrhœa* does *not* include *cholera* (*simple*).

It will be seen that the total death-rate is lowest in the suburban towns, and highest in the other corporate towns. On the other hand the mortality of diphtheria and diarrhœa is highest in the suburban towns, while Adelaide and the other corporate towns approach each other closely in this respect. Adelaide's favourable position is probably due to the deep drainage. The position of the suburban towns seems to indicate an unsatisfactory sanitary condition—probably not actually more so than that which exists in the other corporate towns, but accentuated by a more dense aggregation of population.

Remarks on some Special Diseases.

The diseases which will be considered under this heading are (1) some usually included under the term zymotic, (2) tubercular, and (3) hydatid.

It may be of value to note first one or two zymotic diseases which do not occur in the colony :—

Malarial Fevers.—It has been already seen that the climatic conditions of the colony are such as are unfavourable to the occurrence of these fevers; and they are absolutely unknown.

Remittent Fever is a term which is frequently found in the Registrar-General's returns; but it has just been seen that it cannot be of malarial origin, and as the only other fever of a remittent type is enteric fever, I have considered myself justified in including it along with this latter disease. When this has been done, I have always stated the fact under the various tables.

Typhus Fever is another disease which has absolutely no existence in the colony; and the reason is apparent, for although sanitary conditions generally are very far from being perfect, yet there is no overcrowding or destitution, and much time is spent out of doors.

Relapsing Fever is also unknown.

Asiatic Cholera has never found a footing in this colony. In fact, it has never directly threatened it; but it has been carried by ships to some of the other colonies which are nearer the usually infected ports. The application of quarantine has, however, been sufficient to prevent its spread.

Smallpox.—Two deaths from this cause are to be found in the Registrar-General's reports—one in the year 1859 and the other in 1887. There is no record of the first-mentioned case, but from inquiries I have made among the older practitioners of the colony (among them the present President of the Central Board of Health), it appears to be extremely doubtful whether the disease was actually smallpox, and I think we may safely ignore this death altogether. The second-mentioned case was undoubtedly a death from smallpox; but the patient died at the Quarantine Station (an island at the mouth of the Port Creek) after removal from an infected ship, and the body was carried out to sea for burial. Thus, it may be affirmed that there have been no deaths from smallpox in the colony. The disease itself has on more than one occasion obtained a footing on the mainland, and it may be of interest to record the steps that were

successfully adopted to stamp it out. But in the first place I may refer to the instance of the death already mentioned, where the application of quarantine was effective in preventing the disease getting into the colony. It was intimated by telegram from St. George's Sound, on the 15th December, 1886, that the s.s. "Preussen" had arrived there with a patient on board suffering from smallpox, supposed to have been contracted at Port Said. The vessel arrived in South Australian waters on the 20th December, and the passengers for this colony were removed to Quarantine Island and placed under medical superintendence. They were then all vaccinated, and of the 27 passengers, five (beside the original patient who died) were attacked with smallpox. Twenty-one days after the last patient was removed to the hospital, the passengers were released, and the patient with their attendants were set free when all danger of infection was considered to be past. It may be mentioned that of the 235 passengers landed at Melbourne and 312 at Sydney, in quarantine, there were attacked with smallpox 29 and 79 respectively; but in neither instance did the disease pass beyond the boundaries of the quarantine stations. There were two occasions on which the disease appeared on the mainland. In 1884 a man who had travelled overland from Melbourne in search of work was found by the police near Bordertown, suffering from delirium. He was taken to the police station, and soon developed an eruption which was supposed to be chicken-pox. After some days one of the policemen became ill and showed a similar eruption. The police station was then immediately put in close quarantine, and a medical gentleman was sent to take charge. Another policeman became affected, but the disease was confined to these three patients. In the meantime, vaccination of persons residing in or near Bordertown was recommended and practised. Strict quarantine was maintained for about a month, and then every article of clothing or furniture that might become the medium of infection was burnt.

The next occasion was in 1889. The s.s. "Yarra" arrived at the anchorage on the 6th November, and reported a case of supposed chicken-pox which was convalescent, and also a mild case of gastric fever. Pratique was granted by the port health officer after inspection and full enquiry, and the passengers were accordingly allowed to land. One passenger went to a boarding-house in North Adelaide, and it was subsequently discovered that he had shared the cabin with the supposed chicken-pox patient and was himself the patient who had suffered from the gastric fever. On the day following his

landing he was seen by a medical man, who, from the history of the case and the appearance of an erruption on the face, became suspicious of smallpox, and communicated with the President of the Central Board of Health. A consultation resulted in the opinion that it was a case of modified smallpox, and the patient at once consented to his removal to the quarantine station. The house was also placed in quarantine by a cordon of police, who were not withdrawn until the house was thoroughly disinfected. It was practically impossible to trace all the passengers from the ship, but a printed circular was issued to medical practitioners requesting the earliest information about suspicious cases. On November 19th it was reported that a servant girl at the above-mentioned boarding-house had febrile symptoms and a vesicular eruption, and she was also removed to the quarantine station. The other inmates of the house also agreed to submit to isolation at the station, and they were all placed under medical supervision. It turned out that the girl had washed some of the first patient's body linen on his coming from the ship. She had smallpox in its most virulent form, and an attendant who waited on the first patient also took the disease in a mild form. None of the other inmates of the house were attacked. Everything in the house at North Adelaide which could not be disinfected by heat or boiling was burnt, and the walls were thoroughly disinfected at the expense of the Government. After the lapse of twenty-one days it was evident that the disease was effectually stamped out.

These are the only instances known of smallpox existing in the colony, and they serve to illustrate the manner in which it may be introduced—by oversea or overland communication. The duration of the passage from the nearest foreign ports is sufficient to enable any case of smallpox to develop on board, and it has been seen how the application of quarantine, if effective, may prevent the disease getting a foothold in the colony. The other mode of introduction is becoming a source of greater risk every day by the increasing facilities of intercolonial communication, and this danger can only be met properly by the adoption of a system of federal quarantine. If this were done there would be the minimum amount of interference with trade with the maximum amount of security, and if the vaccination laws were strictly enforced in all the colonies it should be possible to exclude the disease altogether. It must be admitted, whatever be the faults and disadvantages of quarantine, that in a new country like this it would be unwise to allow any disease of the gravity of smallpox to obtain a footing, if by any means it can be avoided.

Table XXXI.

Percentage of Monthly Average of deaths. 1866–89.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Influenza	108·4	72·2	48 1	84·3	144·5	132·5	84·3	120·4	156·6	36·1	120·4	96·3
Whooping Cough	134·1	94·4	83·6	59·0	55·7	66·5	57·9	74·0	108·3	103·0	167·3	195·2
Measles	96·8	80·9	84·1	74·6	60·3	74·6	101·5	80·9	90·4	133·3	133·3	188·8
Scarlet Fever ...	80·6	74·4	126·8	101·1	122·2	125·0	134·1	114·8	75·3	74·4	79·9	90·9
Diphtheria ...	64·5	79·0	103·1	125·5	129·7	144·	120·7	95·8	92·3	83·2	90·5	70·6
Croup	55·1	62·7	91·6	124·6	134·8	156·9	137·4	123·8	81·4	77·1	70·3	83·9
Diphtheria plus Croup.	60·6	72·2	98·3	125·1	131·8	149·8	127·8	107·5	87·7	80·7	82·1	76·1
*Enteric Fever ...	114·1	114·6	145·2	170·3	165·7	148·1	66·5	47·3	45·2	41·0	54·8	86·6
*Diarrhœa ...	193·3	160·3	165·7	157·1	106·7	44·7	21·5	14·3	15·7	25·4	112·4	182·4
Phthisis	94·0	84·8	106·3	101·4	105·3	97·5	102·8	102·8	102·8	104·3	94·0	103·4
Tubercular Meningitis.	110·6	119·9	121·9	112·0	100·7	92·1	95·0	69·5	89·3	70·9	95·0	123·4
Other Forms of Tubercular Disease.	112·6	123·3	159·8	152·3	128·7	82·6	63·3	66·5	48·2	51·5	81·5	129·8

* *Enteric fever* includes *simple continued* and *remittent fevers*; *Diarrhœa* includes *dysentery* and *cholera* (*simple*).

Table XXXI. gives the percentage of the monthly average of deaths for the years 1866–89, and is the key of the chart at page 65 which represents what may be called the Seasonal Curves of these diseases.

Influenza is a disease whose fatality has been very limited, and the only year in which it assumed anything like epidemic proportions was in 1860. The exact nature of this outbreak cannot be ascertained. Owing to the fewness of the total number of deaths, the death-rates given in the tables are of little value.

Whooping Cough has had seven well-marked epidemics since 1858—the mortality reaching 879 per million in 1868. During the earlier part of the period referred to, there was a distinct break in the cyclical wave (*vide* Table XXII.); but since about 1871, the mortality, however low it may have been, has never been absent. This seems to indicate that formerly outbreaks of this disease were the result of imported cases, while recently the disease has established a permanent footing. The same remark applies to measles and to some extent to scarlet fever. *The seasonal curve* (Table XXXI.) of whooping cough shows a rise beginning in September, attaining a maximum in December, and falling rapidly after January; but probably it is influenced considerably by complicatory diseases.

Measles.—Since 1858, judging from its mortality record, there appears to have been five epidemics, the highest death-rate being 1,408 per million in 1874. The character of these epidemics may be seen from Table XXII.—the wave of the first and third involving two years, of the second only one. As has already been pointed out, the disease has been persistent since 1873. *The seasonal curve* (Table XXXI.) is rather indefinite, for while the number of deaths is above the average in October and November, attaining a maximum in December, it falls suddenly below the average in January. It is doubtful how far the seasonal curve is of value in those diseases which are liable to sudden epidemic outbreaks, unless other circumstances than seasonal conditions are taken into account.

Scarlet Fever.—Table XXII. *giving the Cyclical Waves* of this disease shows two marked and sudden rises with a secondary wave after the second of the two. These epidemics differ from those of measles, inasmuch as they involve four years in their rise and decline, and do not disappear so entirely in the intervening periods. The highest mortality was 3,631 per million in 1864. *The seasonal curve* (Table XXXI.) shows an increase of deaths above the average from March to August inclusive.

A noteworthy point in regard to measles and scarlet fever is the intensity of the mortality when an outbreak does occur.

Diphtheria.—In various tables of this paper *Diphtheria* has been placed alongside of *Croup*. A glance at the tables and charts which illustrate these tables shows a marked similarity between these two diseases. The cyclical waves do not perhaps correspond very accurately, but this could scarcely be expected, even if the two diseases differed only in name; for instance, an increase in the one might be the result to some extent of the one term being used at the expense of the other, which rather would accordingly show a corresponding decrease. This in fact, appears to be explanation of the apparent increase of diphtheria during the last few years, there being a concomitant decrease of croup; and it indicates a recognition by medical practitioners of the identity of these diseases. This opinion seems to be borne out by the seasonal curves of diphtheria and croup; for they behave so exactly as almost to preclude the idea of their being two distinct diseases. At least, it is evident that the same seasonal influences affect both in a similar manner. I am of opinion that the two combined will give the most accurate view of

the prevalence and behaviour of the disease*; but as their identity is not universally accepted, and in order to avoid confusion in using the figures for purposes of comparison, I have stated them separately as well as combined in the tables. I have already mentioned that I consider diphtheria to be a reliable sanitary index for this colony; for it is more local in its origin and rarely taken out of its own locality for treatment than some other diseases.

Looking at the *Cyclical Wave*, as shown on Table XXII., it appears that the earlier epidemics were more fatal than the later. It is also seen that there has been a constant mortality of some magnitude. Table XXII. has shown the annual death-rates since 1858; and the following Table shows the mortality for groups of years:—

TABLE XXXII.

Mortality stated as per 1,000.	1858–65.	1866–73.	1874–76.	1877–82.	1883–89.
Diphtheria	·584	·514	·312	·260	·307
Croup	·425	·300	·264	·267	·193
Diphtheria plus Croup	1·012	·806	·576	·528	·496

The increase of Diphtheria and the decrease of Croup in the last period have already been explained; but the progressive and marked decrease of the two combined is noteworthy. If the cyclical curve be compared with the various meteorological mean annual curves, there does not appear to be any relationship existing between them; but in order to render this part of the inquiry complete, it would be necessary to separate that part of the year which corresponds to the seasonal rise, and data for this purpose are not at present at my disposal. The *Seasonal curve* (*vide* page 65) is exceedingly well marked. It reaches the average in March, attains the maximum in June, and falls below the average in September, the lowest point being reached in January; hence the period of greatest fatality extends from March to August (inclusive). This period corresponds to the fall in the temperature curves (*vide* page 66), and to the rise in barometric, rainfall, and humidity curves. In regard to the state of the soil, the diphtheria curve begins to rise when the soil

* The Registrar-General's returns include some other terms which are possibly to be regarded as "Diphtheritic," such as Quinsy and Laryngitis; but the deaths from these are very few.

attains its maximum temperature, and the rise in the curve progresses along with an increased moisture in the soil resulting from the rainfall. The connection between the diphtheria curve and these conditions of the soil is borne out by the temporary rise in November, when the soil is fairly moist after the winter rains and at the same time increasing in temperature. As the summer sets in, the moisture in the soil gradually disappears until the winter rains begin.

Enteric Fever.—Under this term I have included *Simple*, *Continued*, and *Remittent Fevers* (unless when otherwise stated); the former, because fatal cases of this description are almost certain to be enteric—in this colony at least; the latter, because as already pointed out, malarial diseases are unknown in the colony, and the only fever of a remittent type is enteric. They are, however, comparatively few in number, so that their inclusion does not materially affect the death-rate of enteric fever.

The *chart* at page 67 shows that there has been a continuous existence of this disease with a decided mortality which was much higher in earlier than later times. The continuous comparatively high rate since 1882 has been explained to be due to mining discoveries; and I have also explained that the external and internal disturbing element of patients being freely removed from one place to another for treatment renders enteric fever an unreliable sanitary index in this colony. It is satisfactory, however, to know that, with the exception of a slight increase in recent years, there has been a progressive decrease in the death-rate of this disease, thus:—

TABLE XXXIII.

Mortality stated as per 1,000.	1858–65.	1866–73.	1874–76.	1877–82.	1883–89.
Enteric Fever, including Simple Continued and Remittent Fevers ...	·663	·629	·597	·423	·467

Comparing the cyclical curve of enteric fever with the mean annual curves of various meteorological conditions (*vide* page 66) no direct relationship appears to exist; but as already stated in regard to diphtheria, it would be necessary (in order to render this comparison valuable) to study these conditions as affecting that part of the year which corresponds to the increased fatality of the disease. For

example, the annual rainfall appears to have no relationship with the enteric curve of mortality; but the amount of rainfall is frequently influenced by an abnormal fall in some particular month or months, and it might be necessary to consider the effect of not only this abnormal fall, but also the rainfall of the part of the year which is associated with the rise in the death curve. The same with temperature and the other conditions.

This extended inquiry would probably yield valuable information, but neither time nor data are at my disposal at present. The *seasonal curve* (*vide* page 65) of enteric fever is well defined, and on this account its meteorological relations can be fairly accurately ascertained. The curve is above the average from January to June (inclusive), attaining the maximum in April, and is below the average from July to December (inclusive), reaching the minimum in October. Enteric fever, however, is a disease of some considerable duration before it terminates fatally, so that the death curve must be distinguished from the curve indicating the activity of the causal micro-organism which we may agree to call the germ curve. The average duration of a fatal case is probably about a month, and as the period of incubation averages about three weeks, the germ curve would have to be placed nearly two months in advance of the death curve on the chart. Thus it would be at its lowest in July, August, and September, beginning to rise in October, attaining its maximum in February (or March), and following rapidly after May. It thus appears that the part of the curve above the average corresponds with the later months of summer and the earlier months of winter (dividing the year as we have done into two seasons). The meteorological curve (*vide* page 66), which it follows most closely, is that of temperature, and rather of the soil than of the air. The other meteorological curves—rainfall, humidity, and barometric pressure—are just beginning to rise at this time; so that their relationship must be a secondary matter. On the other hand, the part of the death curve which is below the average corresponds with the high portions of these latter curves. Accordingly, speaking broadly, we may say that enteric fever is favoured by heat and moderate moisture of the soil, and retarded by cold and excessive moisture. It may be pointed out that the seasonal curve of the city of Adelaide shows a very close resemblance to that of the whole colony, the sharpness of the former being probably owing to the importation of cases.

Diarrhœa.—Under this heading are included the dysentery and

cholera (simple) of the Registrar-General's returns, because they do not occur as separate diseases. It has already been seen that diarrhœa is the most fatal of individual diseases in the colony (being closely approached by phthisis only), and that its victims are largely under five years of age—two-thirds of the total being under one. Involving as it thus does principally an infantile mortality, and for other reasons as already stated, I regard this disease as perhaps the most delicate index of the sanitary condition of the colony. The *cyclical curve* (*vide* page 67) shows a series of well-marked waves—higher in earlier than recent years, but having no apparent relation to the mean annual meteorological curves. The following table shows the progressive and marked decrease in the mortality :—

TABLE XXXIV.

Mortality stated as per 1,000.	1858–65.	1866–73.	1874–76.	1877–82.	1883–89.
Diarrhœa, including Dysentery and Cholera (simple) ...	1·823	1·528	1·542	1·381	1·169

The *Seasonal Curve* (*vide* page 65) is well defined. It takes a sudden rise in November, attains its maximum in January, falls rapidly to nearly the average in May, and reaches its lowest point in August and September. The curve for Adelaide differs slightly from the above, inasmuch as it attains its maximum in December. It is thus evident that diarrhœa is essentially a summer disease, and its curve follows very closely that of the mean temperature. Seeing that it is a disease in which fatal cases are rapidly fatal and the incubation period probably very short, the germ curve will nearly correspond with the death curve. It will be noticed that the death curve rises and falls more suddenly than the temperature curve. Further, if heat were the sole cause of the increase of diarrhœa, we should expect its effect to be cumulative, and consequently a larger number of deaths in March than in December or January; but we find, on the contrary, that the number of deaths in December exceed that in March, although the mean temperature of these two months is nearly the same. In like manner it is found that the curve of temperature of the soil does not correspond. In regard to the other meteorological conditions—rainfall, humidity, and barometric pressure—their

curves are at their lowest when the death curve of diarrhœa is at its highest, and conversely. There are no data obtainable to show the state of the soil as to moisture; but it has already been pointed out that the effect of the winter rains is to saturate the soil—the moisture gradually disappearing as the rainless summer progresses. It seems as if a certain temperature and a certain moisture of the soil were necessary to favour the occurrence of diarrhœa, and that as the moisture disappears the disease decreases in spite of the temperature being maintained. This inference is strengthened by the fact of the disease practically disappearing at the end of summer, when the moisture of the soil again increases, owing to the increased rainfall, but the temperature has at the same time decreased considerably.

A Comparison of the Death Curves of Diphtheria, Enteric Fever, and Diarrhœa.

If we look first at the cyclical waves of the mortality of these diseases, we see that there is a fairly well-marked similarity between the curves of the latter two; and it seems permissible to infer that this similarity is probably the result of similar meteorological conditions affecting both.

Looking now at the seasonal curves of deaths, we notice that they follow each other in a progressive manner; but in order to estimate their relative positions properly, it is necessary to take into account the duration of the fatal cases of these diseases. This has been already referred to. Diphtheria and diarrhœa attain a fatal result in about a week, and their incubation period is also short; hence the germ curve closely corresponds to the death curve. On the other hand, enteric fever attains a fatal result in about a month, and its incubation period averages three weeks; hence, its germ curve would be from six to eight weeks in advance of the death curve. Thus the germ curves would follow each other in the following order—that of diarrhœa first, with its maximum in December or January; that of enteric fever next, with its maximum in February or March; and that of diphtheria last, with its maximum in May or June. It will be noticed that the period intervening between the last two is longer than that between the first two. Assuming a specific micro-organism to have a causal relation to these diseases, the character of all the death curves indicates a period of activity and a period of quiescence, the former showing

itself in the seasonal increase of the disease, and the latter as a consequence outside the body. According to Koch, moisture as well as heat is necessary to the development of these micro-organisms; consequently, their habitat must be the soil in which alone the combination of heat and moisture exists in this colony. We have already seen that practically no rain falls during the summer months; hence, it follows that the moisture in the soil gradually dries up as the summer proceeds. At the beginning of summer moisture will exist at the surface, while towards the end of summer it will only be found at some considerable depth. This may assist to explain the behaviour and the relative position of the curves. It has been shown that the curve of diarrhœa begins to rise rapidly in the early part of summer and declines rapidly after January, and that the curve of enteric fever is at least a month later. The inference is justifiable that the micro-organisms of diarrhœa exist near the surface of the soil, their activity being thus readily induced by the action of heat and moisture, and subsiding again as soon as the moisture disappears; while the micro-organisms of enteric fever probably exist at a greater depth, and so require a longer time for the combination of heat and moisture to affect them. In the case of diphtheria it may be inferred that the micro-organism exists at a still greater depth, as its period of activity does not show itself until near the end of summer; but as it does not attain its maximum until the winter rains have set in, and when the temperature of the soil has begun to subside, it is probable that some other relations may exist. The micro-organisms might require more moisture of the soil than exists in summer, and a not excessively high temperature for their development, and this is borne out by the temporary rise in the curve in November, as well as by the general rise at the beginning of winter; or they might require, after being rendered active in the soil, a certain humidity in the atmosphere, in order to facilitate their further development and spread.

A bacteriological investigation would materially assist in elucidating these points.

Vide Meteorological Charts at page 66.

Phthisis.—It has been seen that phthisis comes next to diarrhœa in order of fatality. The Table XXII. shows a variation in the annual mortality without any very marked rise and fall; but the following table shows that there has been an increase in the mortality in recent years:—

TABLE XXXV.

Mortality stated as per 1,000.	1858–65.	1866–73.	1874–76.	1877–82.	1883–89.
Phthisis	·946	·946	·983	1·024	1·066

Although this does not nearly approach the death-rate of phthisis for England and Wales, yet it is higher than the favourable conditions existing in the colony justify. We have already seen that there is no overcrowding, no noxious trades or injurious occupations, no destitution or privations of any kind. In fact, the conditions usually associated with phthisis are conspicuous by their absence—except general defective sanitation, and this is counterbalanced by the free out-of-door life that prevails. Yet the mortality of this disease exceeds that of every other individual disease (except diarrhœa), and has not decreased in recent years as the zymotic diseases generally have done. This latter fact points to some other cause being in operation than general insanitary conditions. It will be noticed that the *seasonal curve* (Table XXXI.) does not indicate any meteorological relationship. Probably the prevalence of this disease is largely due to two causes, or rather to the extended operation of one cause; namely, the importation of phthisical patients and inherited predisposition. It is a well-known fact that many persons suffering from phthisis come to this colony for the benefit of their health. In some, the disease is so far advanced that they simply come to die, and thus increase the mortality directly. Others obtain benefit from the climate, settle down, marry, and rear children with a predisposition to the disease. Unfortunately, it is impossible to distinguish the deaths of those who have come here suffering from the disease. On the other hand, it has been recently asserted that tubercular disease is very prevalent among cattle in the colony, and if this be so, we have another possible cause of the high mortality of phthisis.

In regard to the therapeutic relation of the climate to phthisis, it has been already shown that almost every variety of climate can be obtained—from the hot dry plains of the interior to the moister conditions of the southern coast line, and the bracing atmosphere of the Mount Lefby ranges. A dry atmosphere can always be found, and the excessive heat of summer can always be avoided.

These points may be remembered with advantage; for patients

are often sent to the colony at any period of the year, and without any nstructions as to the necessity of finding a suitable locality in the colony.

Hydatid Disease.—This is a disease in which it has been conclusively shown that the parasite which is the cause of the disease has an independent existence outside the body, and it is the conditions of this external existence that come within the scope of public health. This colony has unfortunately attained some notoriety in the matter of this disease; hence, it will be interesting to enquire how this has come about. The following remarks are largely based upon the work on "Hydatid Disease" by Dr. J. D. Thomas, of Adelaide. Previous to 1871 there is no mention of this disease in the Registrar-General's returns, and it is only since 1880 that the deaths have been classed separately. The following table gives the statistics as far as obtainable.

TABLE XXXVI.

Year.	Deaths from Hydatid Disease.			Total number of deaths from all causes.
	Males.	Females.	Total.	
1871–79	11	10	21	
1880–81	9	4	13	
1882	7	5	12	4,393
1883	6	—	6	4,432
1884	9	3	12	4,789
1885	4	1	5	3,987
1886	8	10	18	4,234
1887	4	5	9	3,944
1888	9	4	13	3,759
1889	5	6	11	3,501

Dr. Thomas estimates that during the twenty years (previous to 1884), from 2,500 to 3,000 persons suffered from this disease.

The following are among the conclusions arrived at by him:—"That the disease known as hydatids in man and the domestic herbivora, is occasioned by the development of a special bladder-worm (Echinococcus), derived from the eggs of a small tapeworm (Tænia Echinococcus), whose usual habitat is the upper half of the small intestine of the dog;" and, "that for all practical purposes the domestic dog must be regarded as the direct source of hydatid

infection in man and the domestic herbivora." "It follows that if Echinococcus be introduced into a new country, its spread will be determined by four factors—(1) By the number of dogs in the country; (2) by the opportunities that exist for enabling the eggs bred in the dog to be swallowed by man and the domestic herbivora; (3) by the number of domestic herbivora—sheep, oxen, pigs, &c.; (4) by the frequency with which dogs eat the organs of infected sheep, &c., containing living hydatids." "Given a country with many sheep, &c., the organs of which are often eaten raw by the dogs—if the water supply be scanty and procured from bogs, swamps, waterholes and drains, on the banks of which dogs may deposit the eggs, to be blown in by the winds or washed in by the rains, and there be dogs in abundance—we then have all the conditions necessary to the spread of the disease." It has been already shown in this paper that these conditions in regard to water supply do exist in the colony. In regard to sheep, horned cattle, and domestic herbivora, there are per 100 inhabitants respectively about 2,400, 110, and 2,500 in the colony, as compared with 93, 29, and 122 in Great Britain. The number of dogs is difficult to estimate, but it is very great and in excess of their usefulness. Dr. Thomas examined thirty stray and unregistered dogs which had been captured by the police, and found that 40 per cent. were infested with Tænia Echinococcus. Thus we see that all the conditions necessary for the spread of hydatid disease exist in the colony. The following measures are recommended for its prevention—(1) The number of dogs should be diminished by means of registration, and the destruction of unregistered animals; (2) dogs should be excluded from slaughter-houses, and should be fed on cooked meat; (3) the water supply should be protected from the invasion of dogs, and tanks from the entry of dust, while the water itself should be filtered or boiled. There can be no doubt that Hydatid disease is one which is eminently controllable and comes within the scope of preventive medicine.

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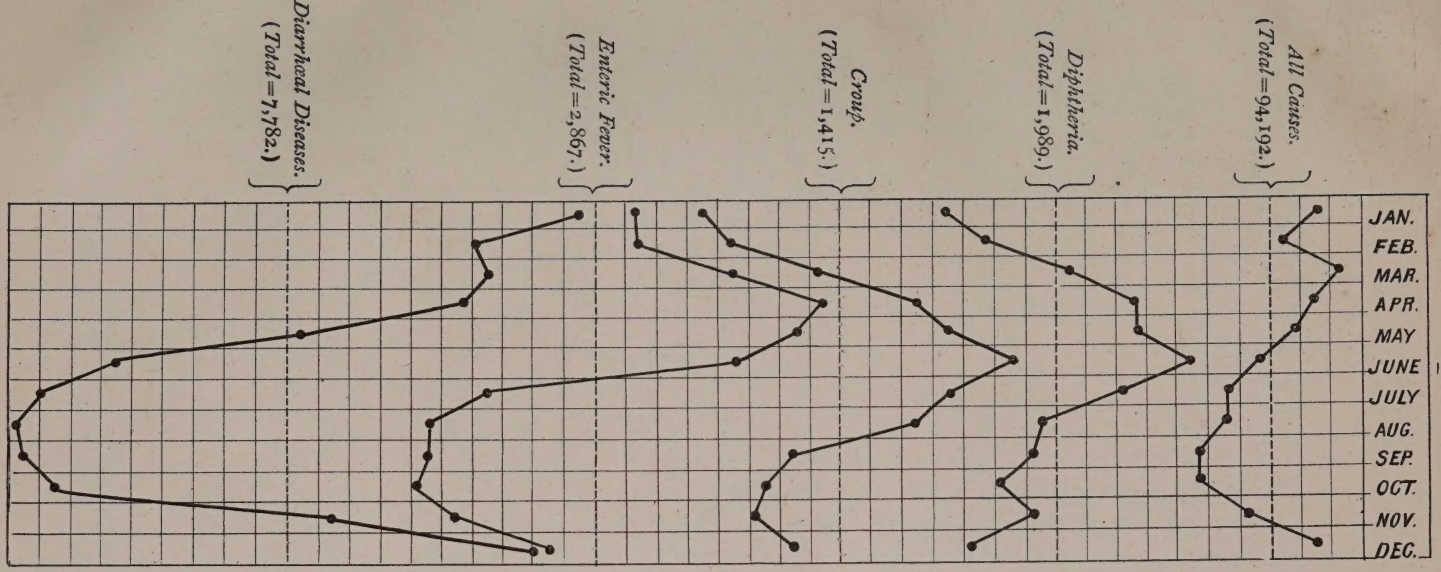

Seasonal Curve of Deaths—shown as percentages of the monthly average, and based upon the total number of deaths in the years 1861–1889, *in the case of deaths from all causes, and in the years* 1866–1889, *in the case of the diseases specified.*

Each division corresponds to 10 *per cent. above and below mean annual number of deaths represented by the dotted line.*

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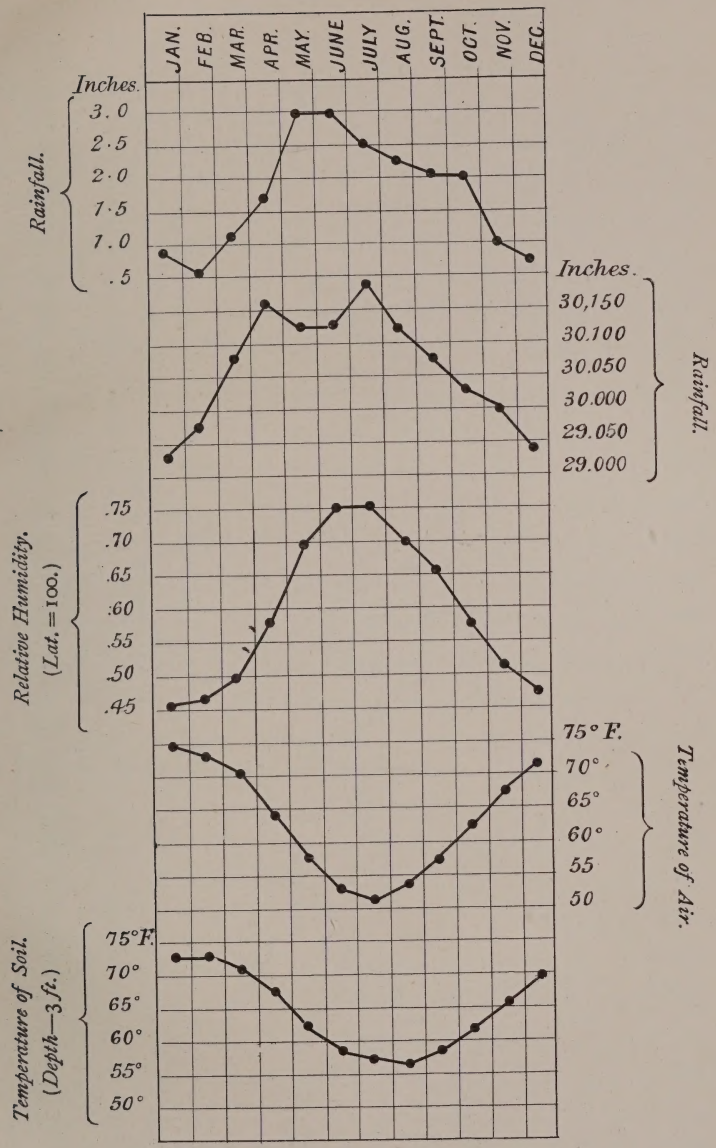

Curves showing the monthly means of Rainfall, Barometric Pressure, and Temperature of the Air for the years 1866–1889, *and of Relative Humidity and Temperature of the Soil for the years* 1867–1889.

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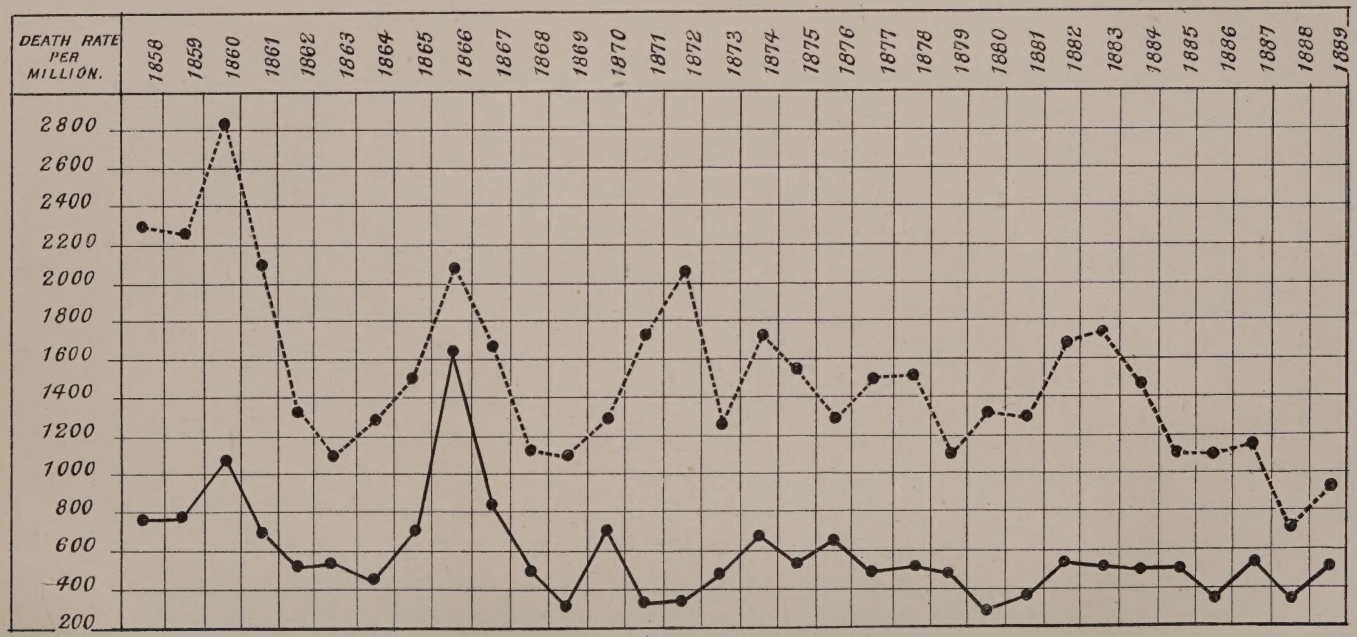

Cyclical Waves represented by the Death-rate per million of Enteric Fever (straight line) and Diarrhœa (dotted line).

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